Aviation Week
and Space Technology

A McGraw-Hill Publication

January 23, 1961

PILOT REPORT:

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Sikorsky S-60 Skycrane

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ADVANCED PROJECTS

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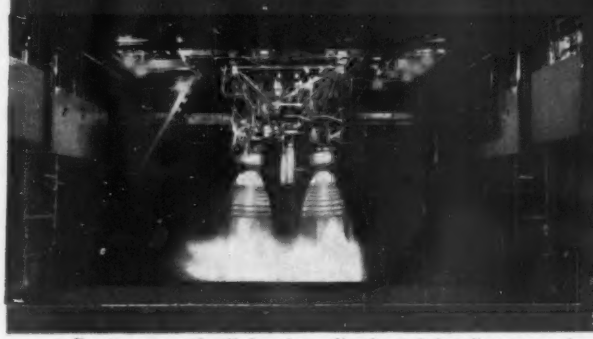
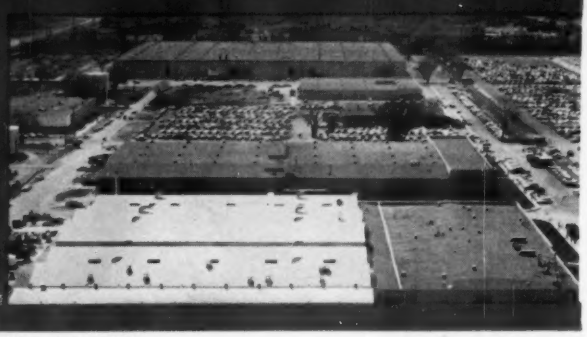
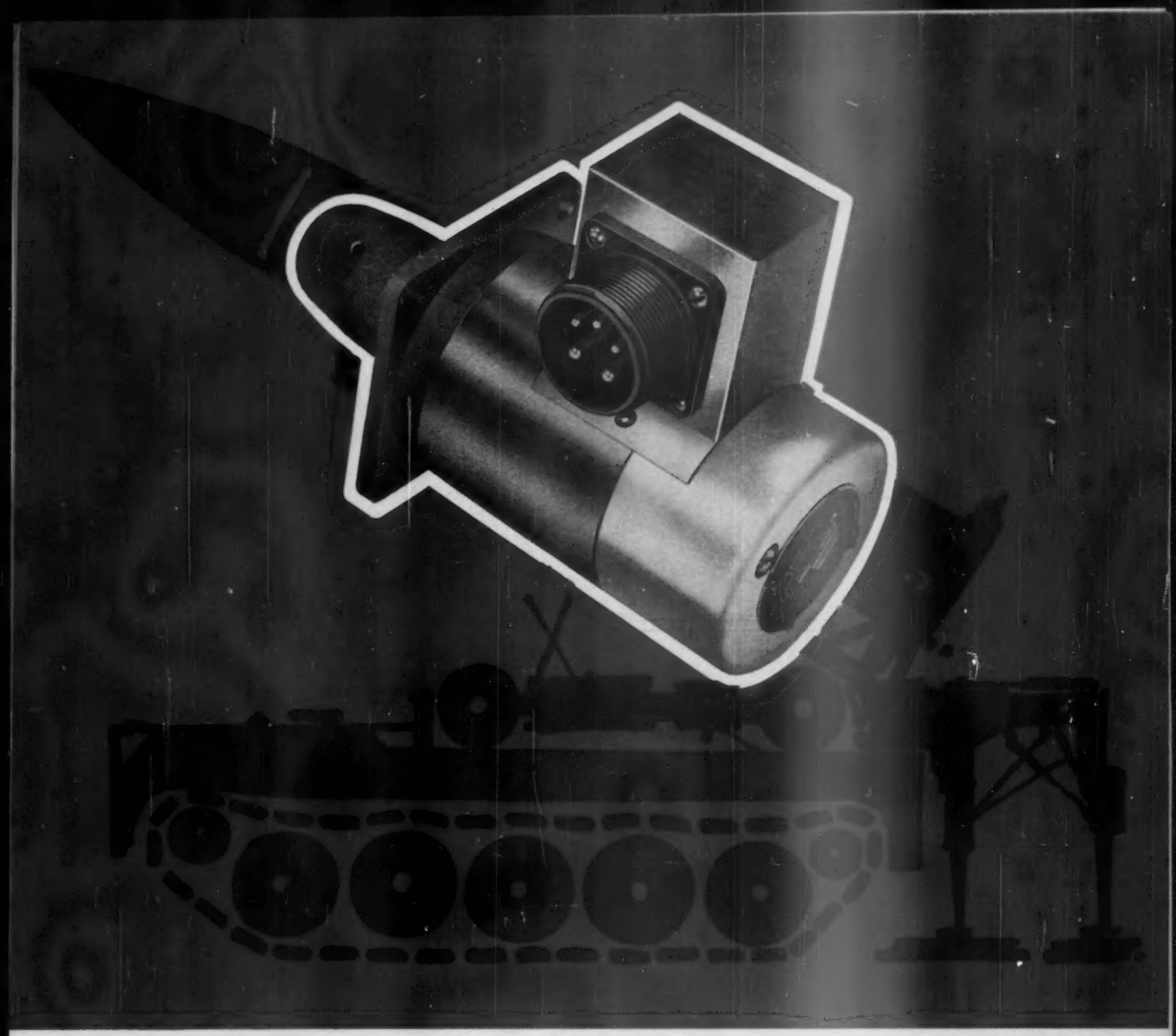




Engineers, scientists—investigate outstanding opportunities at Aerojet



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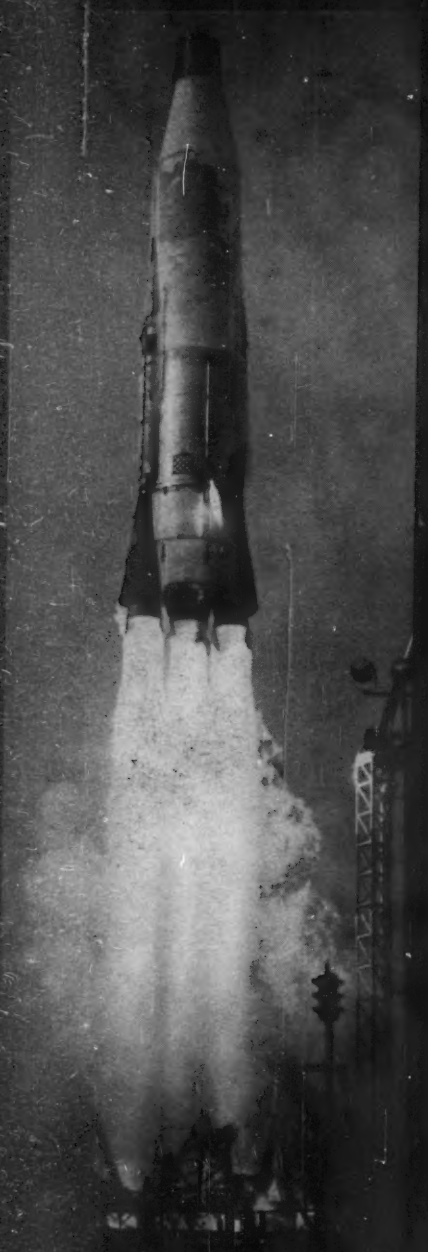

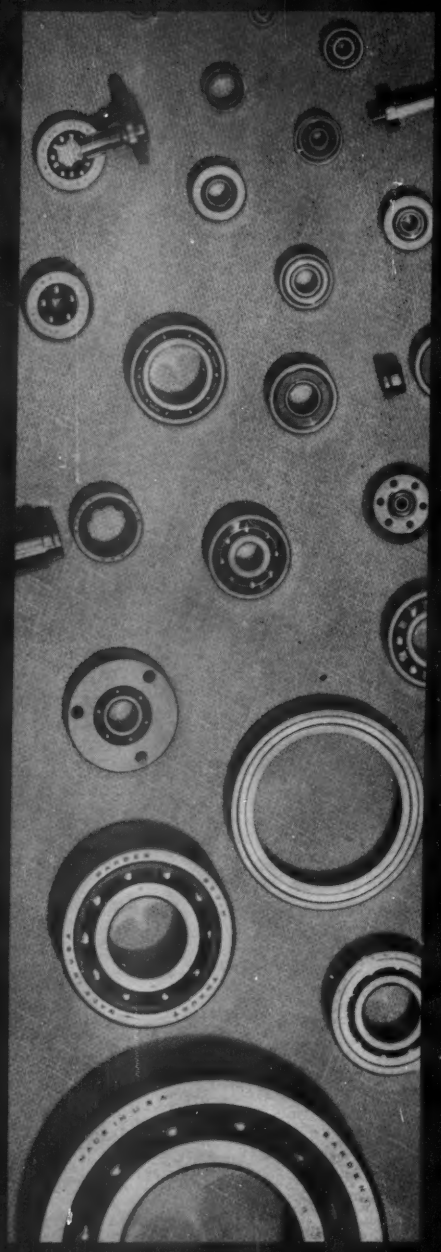

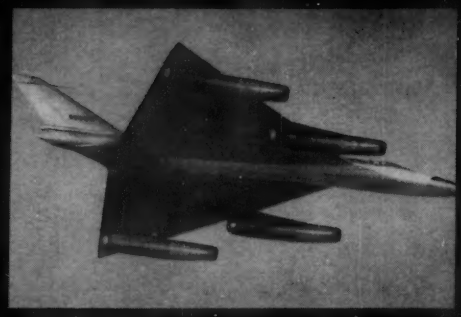

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AVIATION CALENDAR

Feb. 1-3—Second Winter Military Electronics Convention, Institute of Radio Engineers, Biltmore Hotel, Los Angeles.

Feb. 1-3—Solid Propellants Conference, American Rocket Society, Salt Lake City.

Feb. 14-16—Second Annual Symposium on Non-destructive Testing of Aircraft and Missile Components (unclassified), Society for Non-destructive Testing and Southwest Research Institute, Gunter Hotel, San Antonio, Tex.

Feb. 15-17—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel, Philadelphia.

Feb. 16-17—Symposium on Recent Developments in Materials for Nuclear Applications, University of New Mexico, Albuquerque, N. M.

Mar. 5-9—Sixth Annual Gas Turbine Conference and Exhibit, American Society of Mechanical Engineers, Shoreham Hotel, Washington, D. C.

Mar. 9-10—Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia.

Mar. 9-10—Flight Propulsion Meeting, Institute of the Aeronautical Sciences, Cleveland, Ohio (classified).

Mar. 12-16—Aviation Conference, American Society of Mechanical Engineers, Statler-Hilton, Los Angeles, Calif.

Mar. 13-16—Missile and Space Vehicle Testing Conference, American Rocket Society, Biltmore Hotel, Los Angeles, Calif.

Mar. 16-18—Fifth National Conference on Aviation/Space Education, Mayflower Hotel, Washington, D. C.

Mar. 20-23—International Convention, Institute of Radio Engineers, Coliseum and

(*Continued on page 6*)

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AVIATION CALENDAR

(*Continued from page 5*)

Waldorf Astoria Hotel, New York, N. Y.

Mar. 20-24—1961 Western Metal Exposition, American Society for Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

Mar. 27-31—1961 Symposium on Temperature, Its Measurement and Control in Science and Industry, Columbus, Ohio. For information: V. W. Sikora, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

Mar. 28-29—Nucleonics in Flight Symposium, American Nuclear Society, Statler-Hilton Hotel, Dallas, Tex.

Apr. 4-5—Aviation Technician School Administrators Conference, Purdue University, Lafayette, Ind.

Apr. 4-6—International Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Apr. 4-6—Lifting Re-entry Vehicles: Structures, Materials & Design, American Rocket Society, Palm Springs, Calif.

Apr. 4-7—National Aeronautic Meeting, Society of Automotive Engineers, Commodore Hotel, New York, N. Y.

Apr. 10-11—Spring Meeting, Western States Section/The Combustion Institute, Aeronutronic Division of Ford Motor Co., Newport Beach, Calif.

Apr. 13-14—Institute of the Aerospace Sciences/Army Aviation Meeting (classified), Washington, D. C.

Apr. 17-28—14th Technical Conference, International Air Transport Assn., Queen Elizabeth Hotel, Montreal, Canada.

Apr. 18-20—Symposium on Chemical Reactions in the Lower and Upper Atmosphere, Stanford Research Institute, Mark Hopkins Hotel, San Francisco, Calif.

Apr. 20-22—General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.

Apr. 22-25—Annual Business Meeting and Conference, American Assn. of Airport Executives, Broadmoor Hotel, Colorado Springs, Colo.

Apr. 26-28—Liquid Rockets, Propellants and Combustion Conference, American Rocket Society, Palm Beach Biltmore, Palm Beach, Fla.

Apr. 30-May 4—Seventh National Aero-Space Instrumentation Symposium, Instrument Society of America, Adolphus Hotel, Houston, Tex.

May 8-10—National Aeronautical Electronics Conference, IRE, Miami and Biltmore Hotels, Dayton, Ohio.

May 9-11—Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.

May 15-17—National Symposium on Microwave Theory and Techniques, IRE, Sheraton Park Hotel, Washington, D. C.

May 15-18—20th Annual National Conference, Society of Aeronautical Weight Engineers, Sheraton Hotel, Akron, Ohio.

May 22-24—National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 22-24—Fifth National Symposium on Global Communications, Institute of Radio Engineers, Hotel Sherman, Chicago.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

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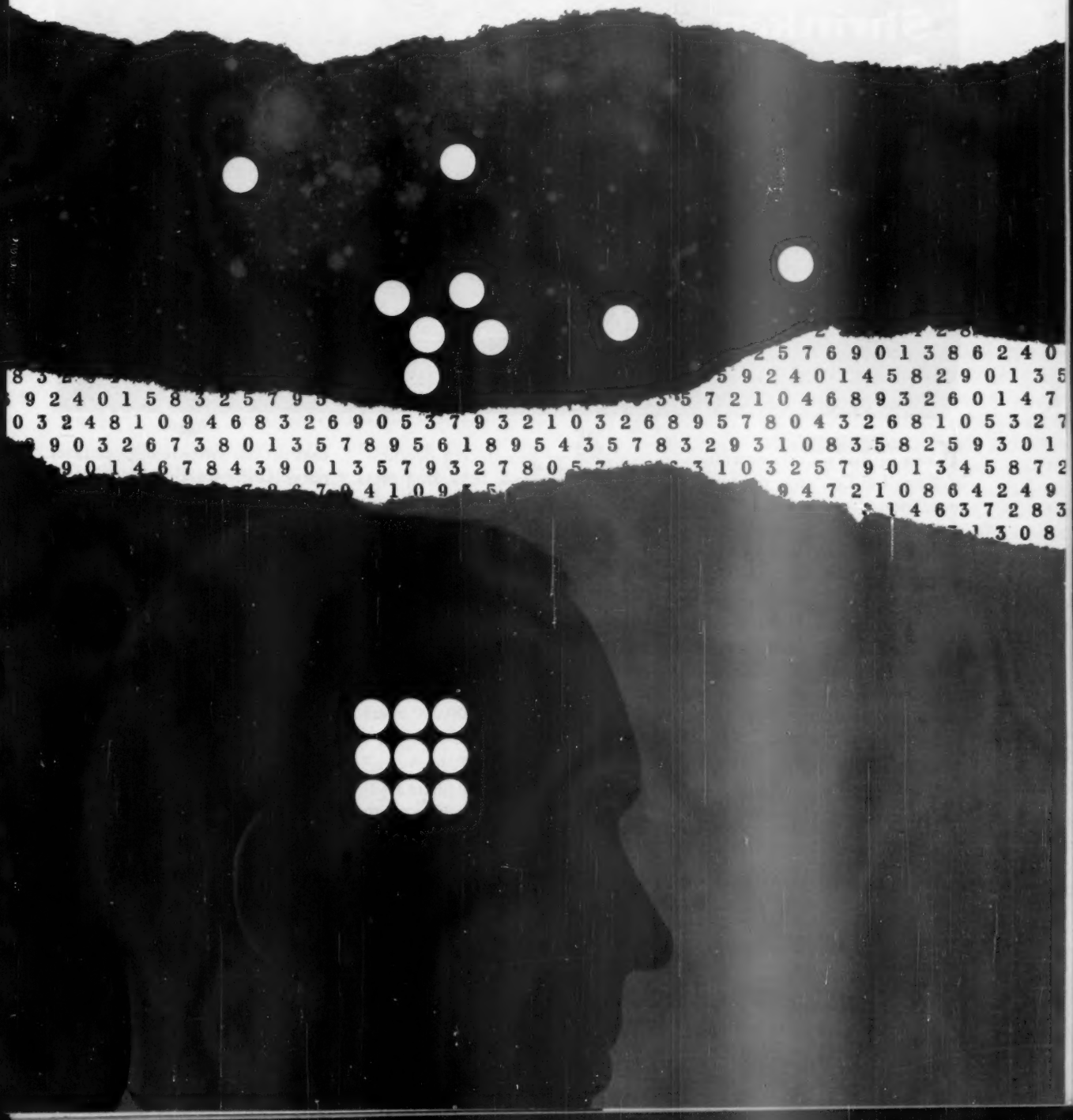

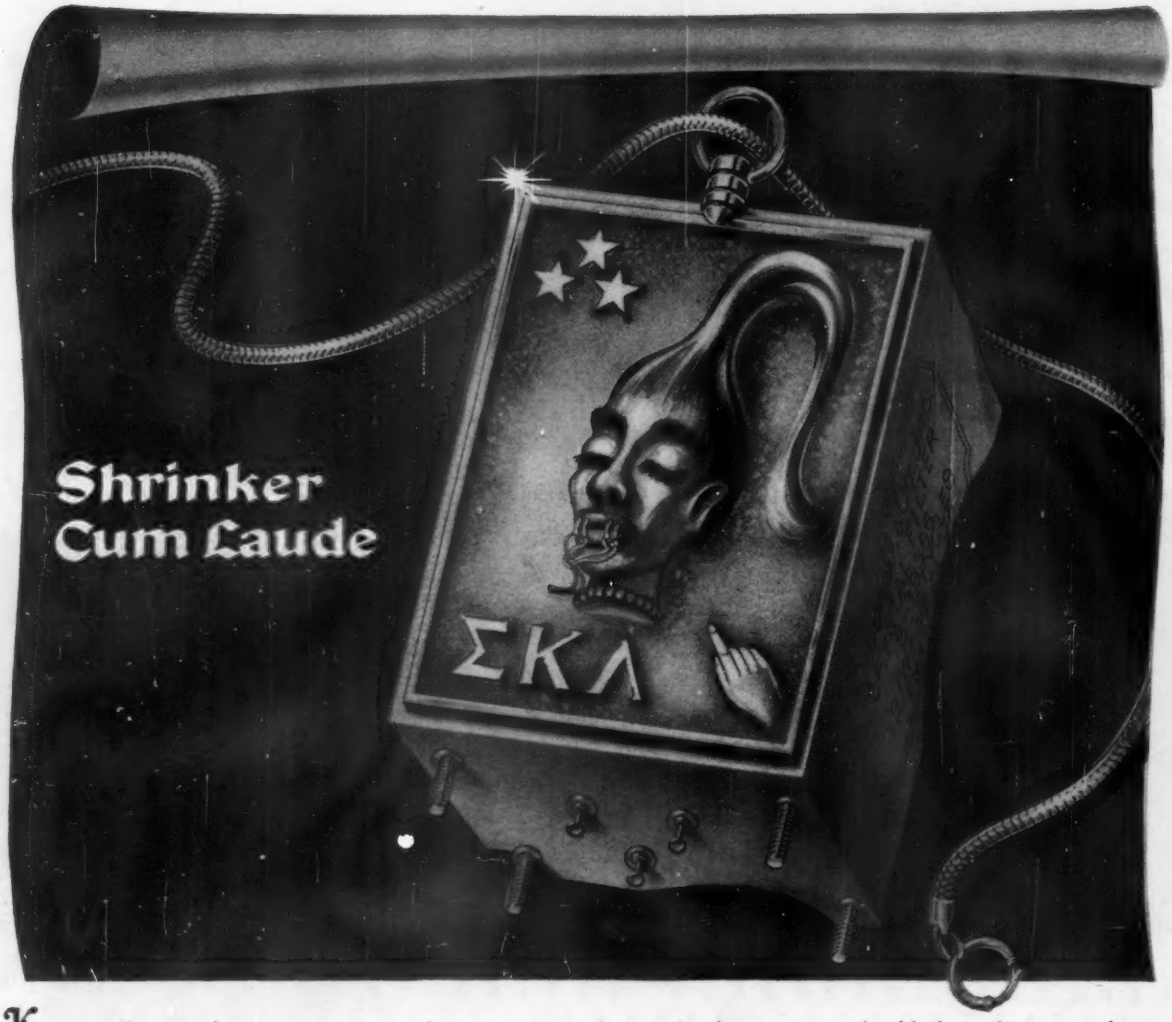

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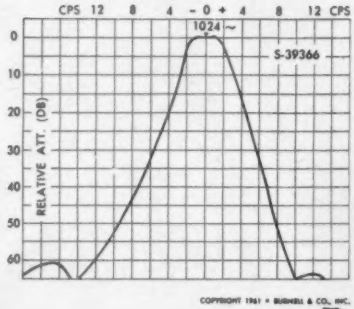

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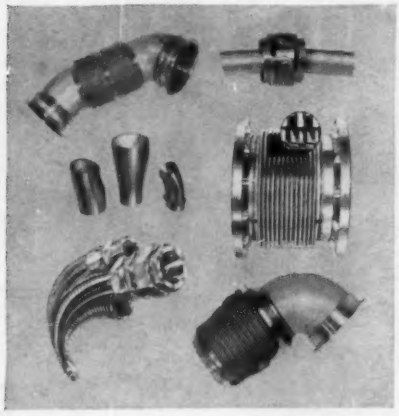

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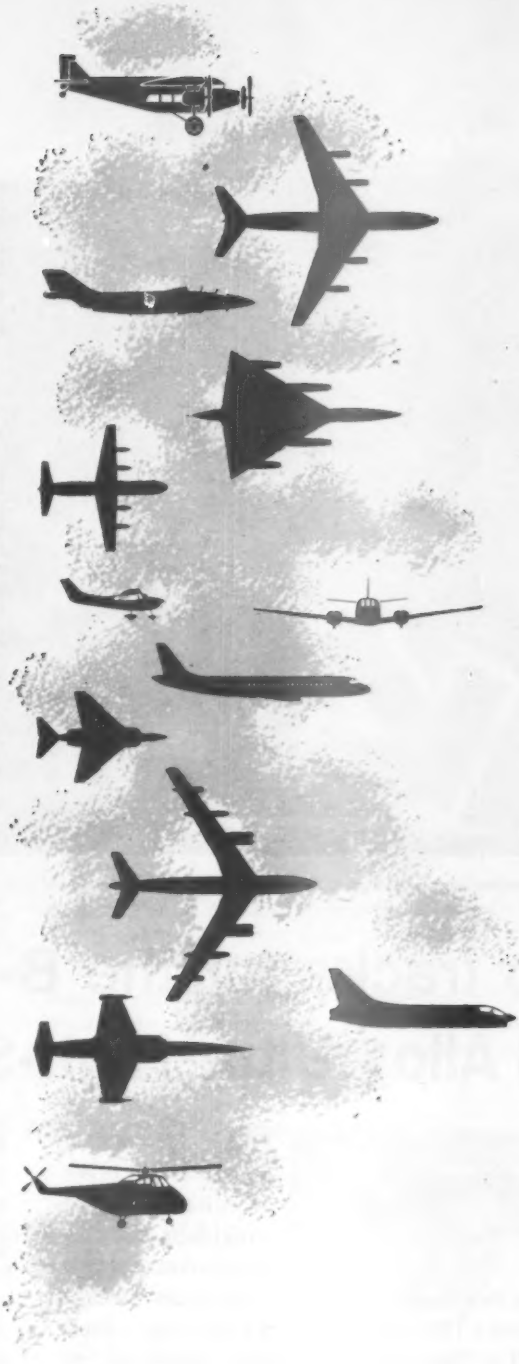

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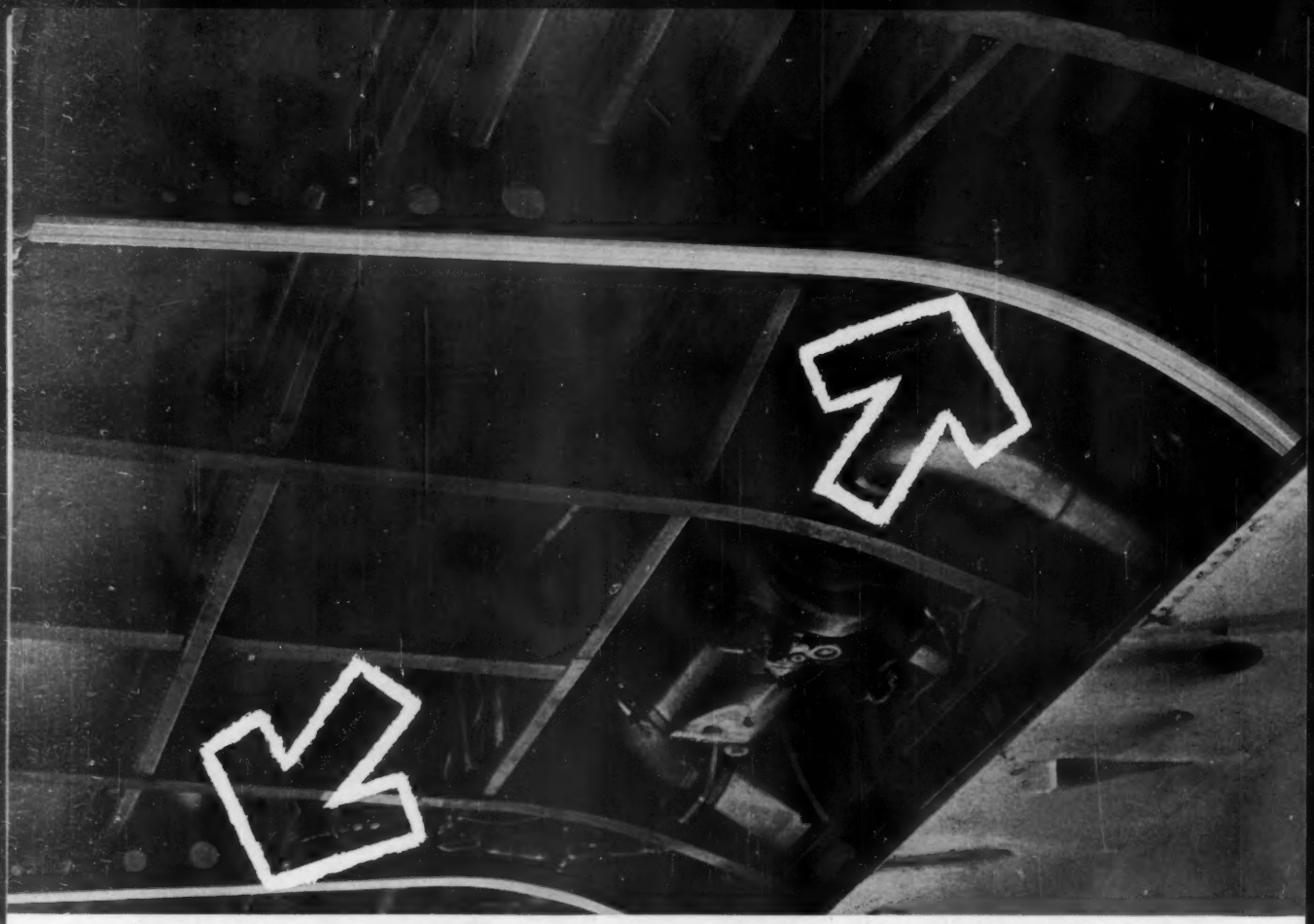

Arrows show wing flap tracks on the B-52 made from USS Alloy Steel heat treated to 180,000 psi minimum tensile strength. Fabrication by Rohr Aircraft Corporation.

Flap tracks for the B-52 made with USS Alloy Ultra-High-Strength Steel

When the 400,000 pound B-52 takes off or lands with the wing flaps down, a tremendous strain is put on the flap tracks. These vital assemblies are fabricated from a USS Alloy *Ultra*-High-Strength Steel —a Ni, Cr, Mo, Va composition produced to AMS6428, and heat treated to 180,000 psi minimum tensile strength.

Wing flaps must operate perfectly every time. That's why the tracks are built with a steel that assures toughness and wear resistance along with *ultra*-high strength and light weight.

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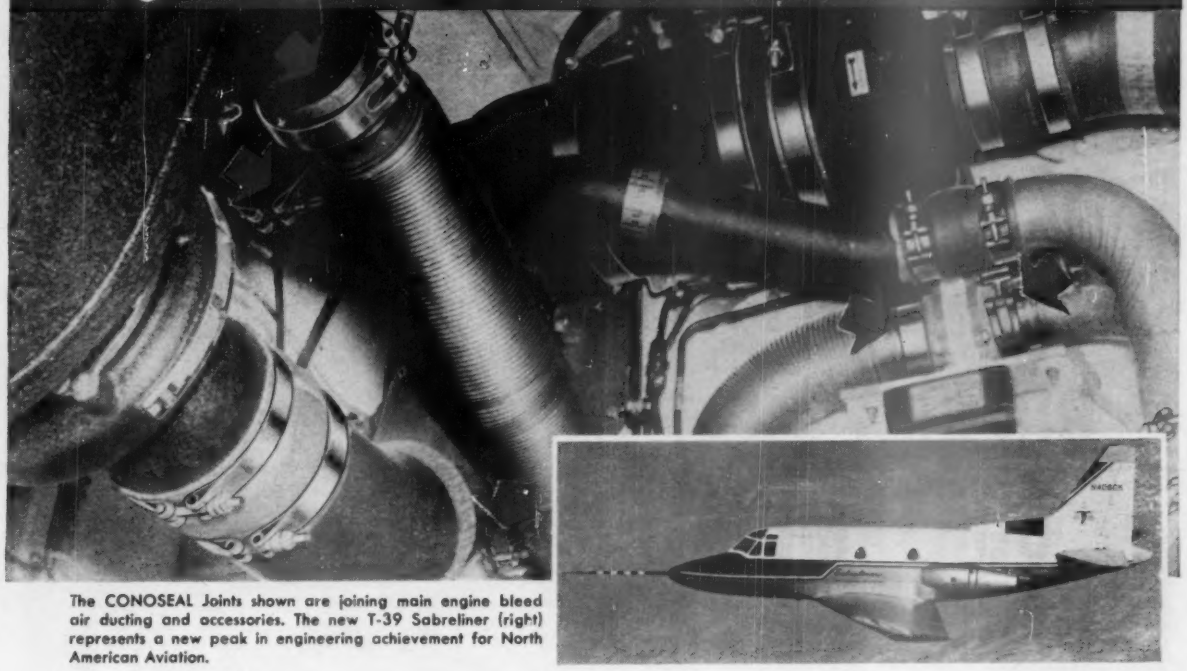
MARMAN CONOSEAL Joints Connect Engine Bleed Lines on New Sabreliner



The CONOSEAL Joints shown are joining main engine bleed air ducting and accessories. The new T-39 Sabreliner (right) represents a new peak in engineering achievement for North American Aviation.

North American Aviation uses 27 Marman CONOSEAL Joints to connect critical high-performance lines on each new twin-jet Sabreliner. To solve other fastening and joining problems on this sleek new utility transport, North American also uses Marman Band Clamps and Tail Pipe Couplings.

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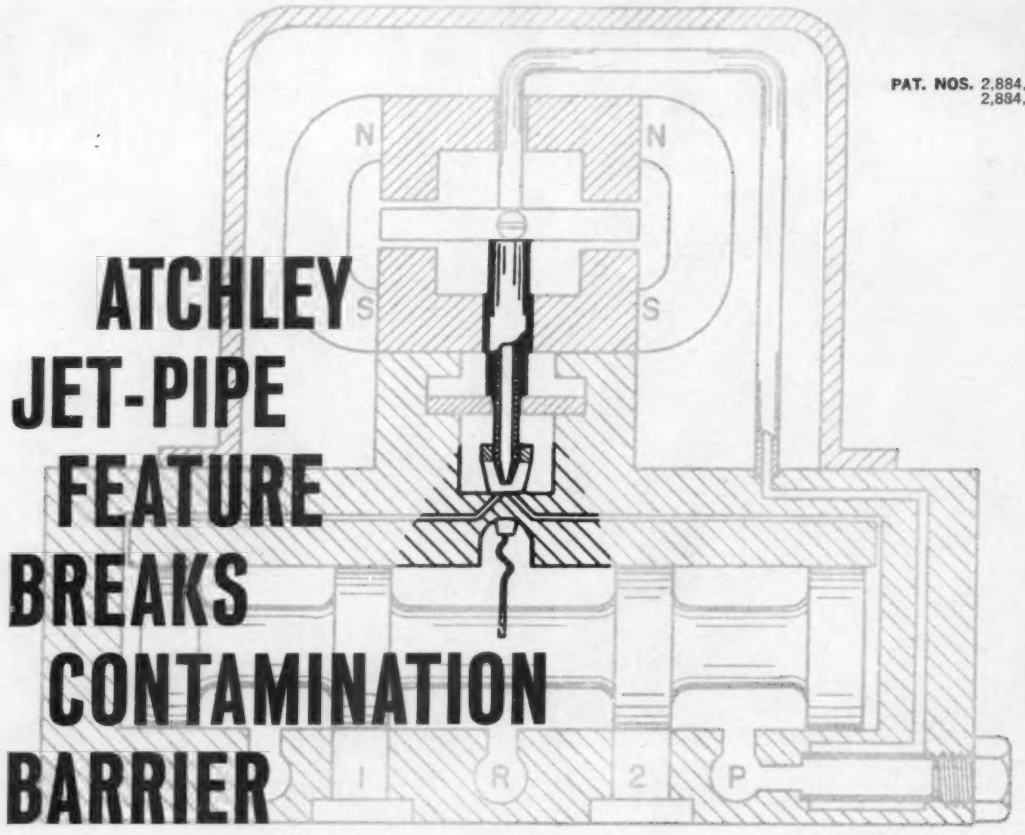

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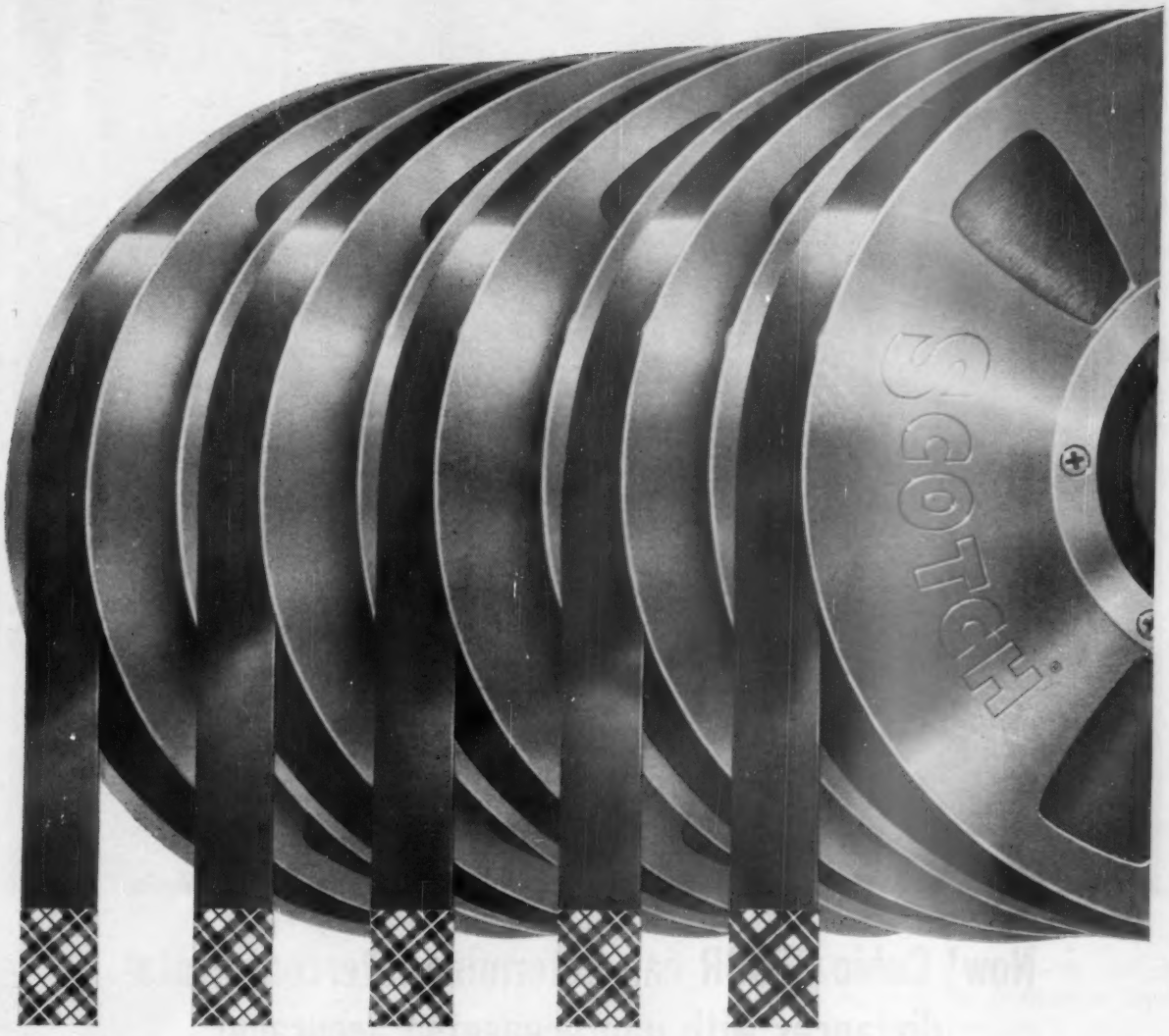

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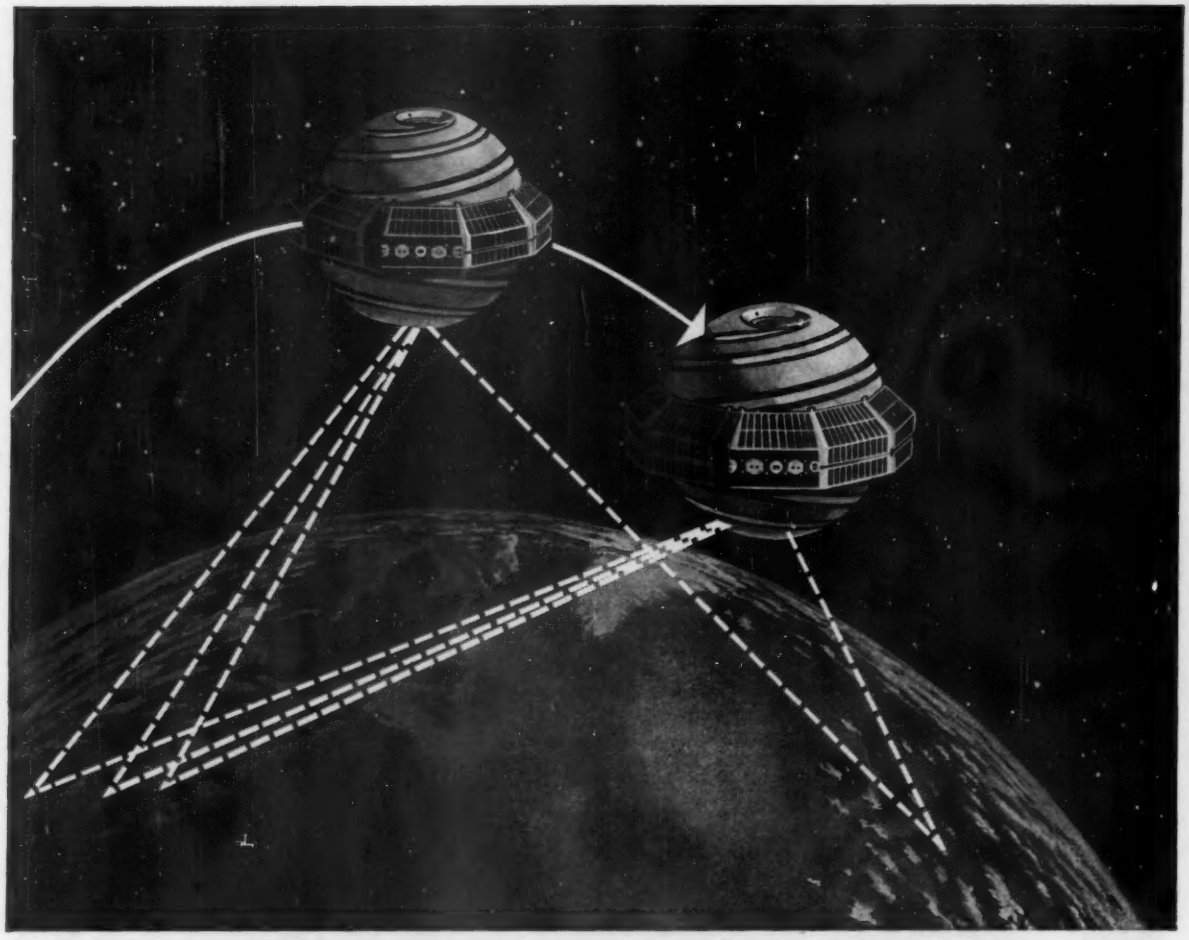

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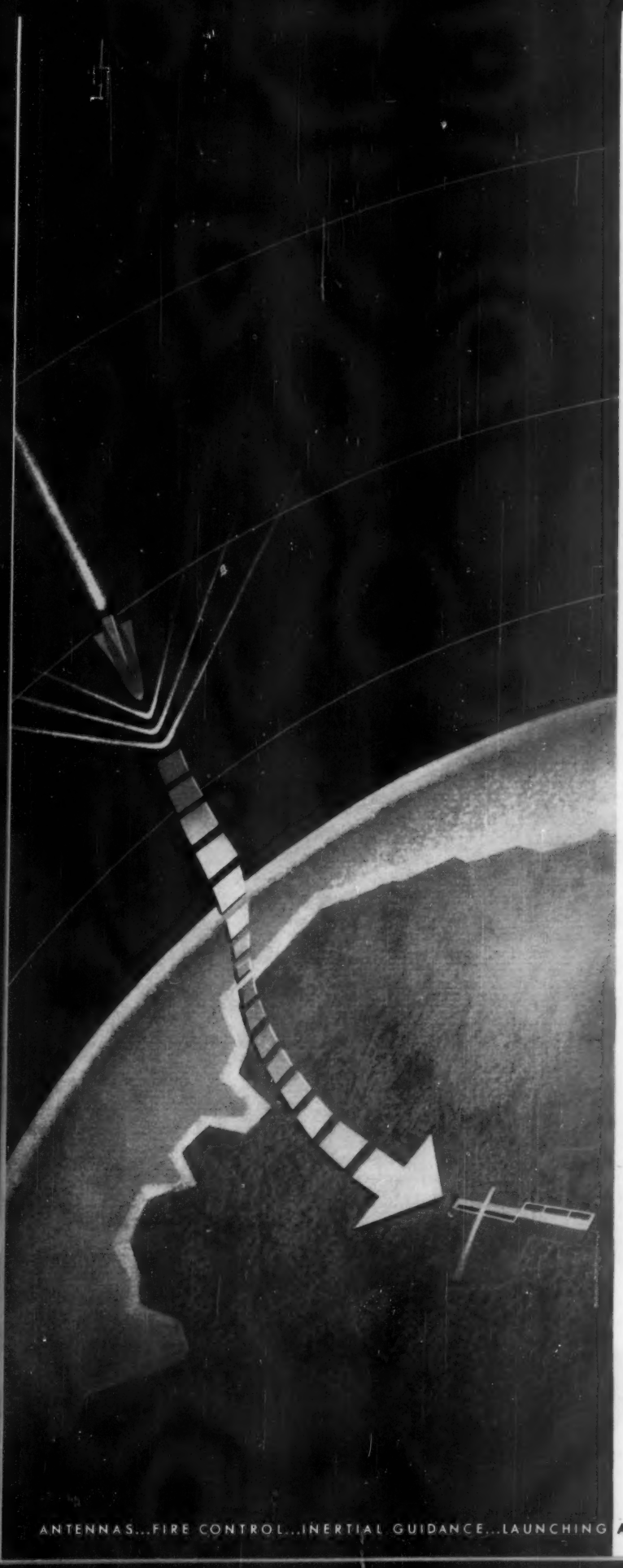

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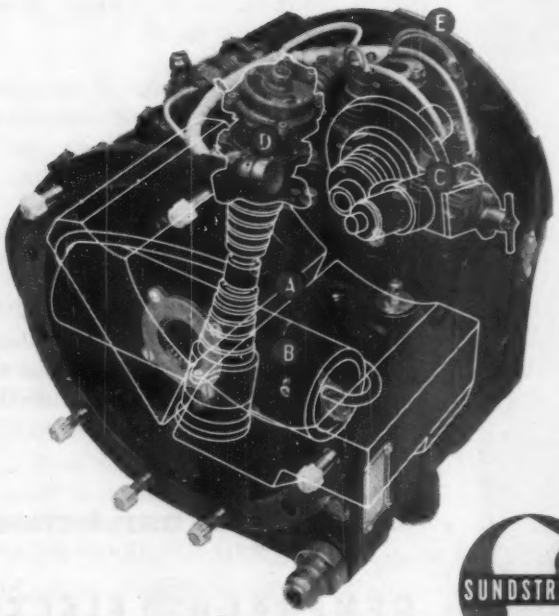

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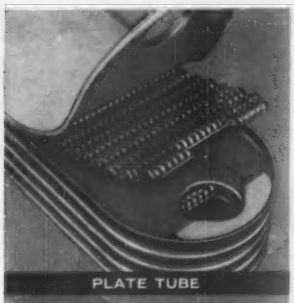
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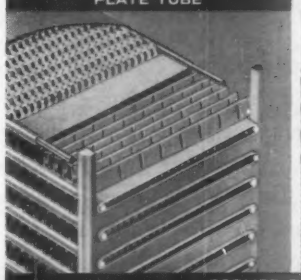
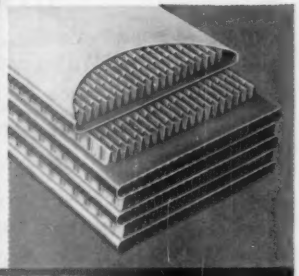
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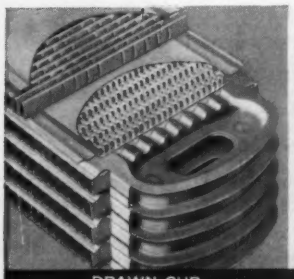
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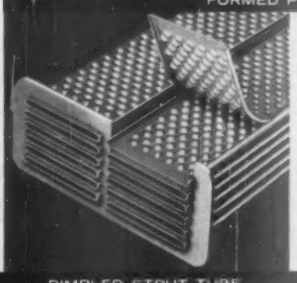
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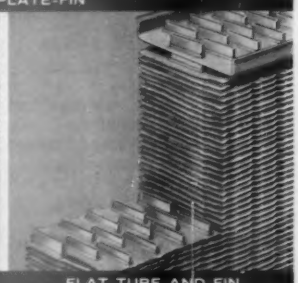
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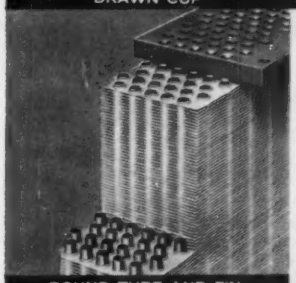
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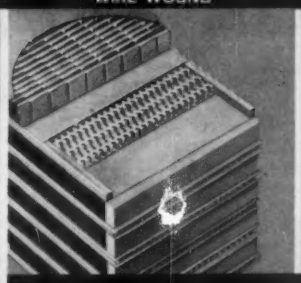

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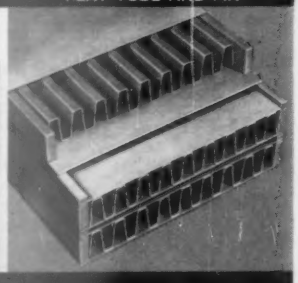

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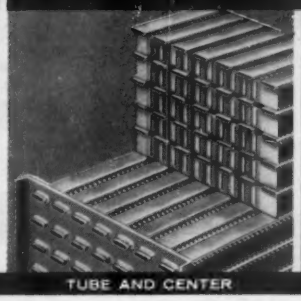
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PICTURE CREDITS
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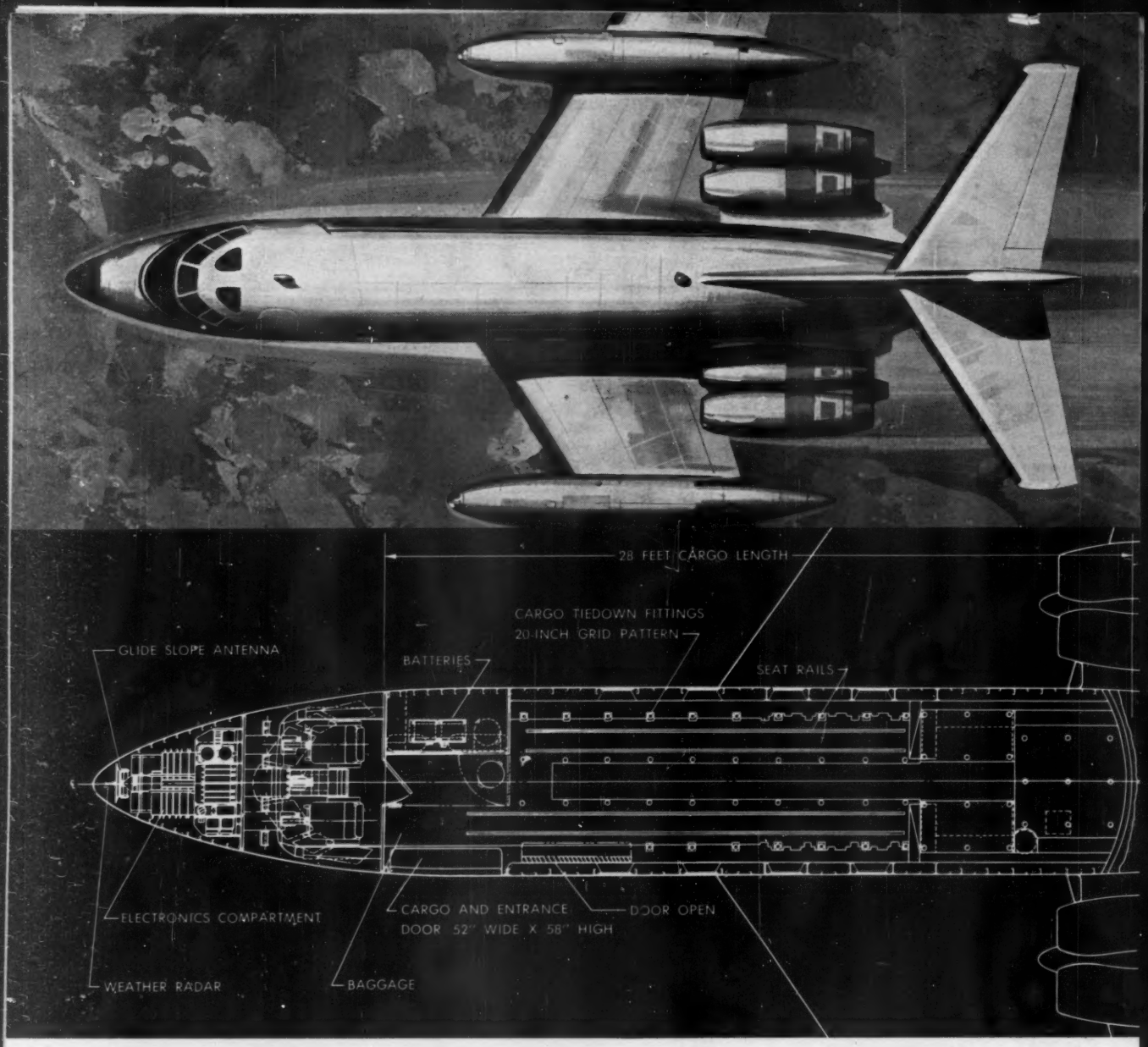

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EDITORIAL

The Parthian Shots

In taking his official leave of the nation via television President Eisenhower fired Parthian shots at the two groups that have caused him the most official embarrassment in recent years and whose concern over his policies he never really understood. It will probably come as a considerable surprise to the millions of people in the military-industry complex of the defense effort and the smaller group of scientists and engineers who have worked so hard in the face of so many official obstacles to bring this country into the forefront of the new technologies to learn from President Eisenhower that he regards them as serious threats to the future liberty of this nation. We doubt if any significant percentage of the American people will share the outgoing President's fears and we certainly don't.

It is true that the past five years have been a period of unruly turmoil in the Pentagon spiced with pungent criticism of the President's military policies. It is also ironic that the country's most experienced military leader had far greater difficulty in maintaining discipline in the defense establishment during peacetime than either of his two predecessors in the White House did during wars.

All of the great public wrangles such as Jupiter vs. Thor; Nike vs. Bomarc; minimum deterrent vs. massive retaliation and the many others that filled the headlines of the past five years reached their epic proportions because of a complete inability of the President and his civilian appointees in the Pentagon to make decisions or to organize and execute effective military planning in the new technologies.

Discipline Restored

It is notable that Defense Secretary Gates, applying both courage and intelligence to his operations, has restored a large measure of the lost discipline of civilian control in his brief tenure at the Pentagon helm. It would appear from the caliber of the new appointees to the top Pentagon jobs plus the high level of prior Pentagon experience in their ranks that the Kennedy Administration will not find the military-industry defense complex beyond their managerial capabilities. Nor are they likely to permit the constitutional demands of civilian control of the military establishment to slip from their grasp.

If President Eisenhower found his relations with the military establishment difficult he was even more irritated by his experience with the scientists forced on him by the explosive impact of the new technologies of nuclear physics, electronics, hypersonics and space. The American people will recall that it was not until after the Soviets had launched the first Sputnik that the President saw fit to appoint a scientific adviser and in a grand gesture invite the leading scientific minds of the nation to a White House gala dinner. This dinner was never repeated nor did any scientific minds of note, with the exception of the single official adviser, ever penetrate the White House inner circle for any continuous input into the President's thinking.

It is certainly understandable to find an older man successful with older military techniques sorely vexed by energetic young men whose discoveries spawned perplexing new problems for the chief executive's administration of the nation. But it is tragic that this gulf was permitted to widen to the dimensions so clearly revealed by President Eisenhower's bitter warning of the danger "that public policy could itself become the captive of a scientific-technological elite."

A Glaring Example

The difficulty President Eisenhower had in understanding the implications of the technological revolution that has so radically changed the world is typified in his final budget message on the Aircraft Nuclear Propulsion program. There he blandly ordered the technicians to arbitrarily and immediately select one of two widely divergent approaches to the problem regardless of the fact that neither has yet been developed to a point where the technical data required for a wise choice is available.

We agree with President Eisenhower's thesis that "only an alert and knowledgeable citizenry can compel the proper meshing of the huge industrial and military machinery of defense with our peaceful methods and goals so that security and liberty may prosper together." But we respectfully suggest that the American people need considerably more candor from their executive leaders and considerably less manipulation of the news to conform to preconceived policies than has been the fashion if they are to be sufficiently "alert and knowledgeable" to measure up to the severe challenge of our times.

It is one of the tragic hallmarks of the era just ending that our executive leaders did not fully understand the implications of the new technologies on military power and the position of this nation in the international community. From the caliber and experience of the leaders now being appointed to these positions of executive leadership in the new government it is evident that President Kennedy realizes he must strive hard to achieve this understanding which is so vital to cope with the problems that beset us on all sides.

—Robert Hotz

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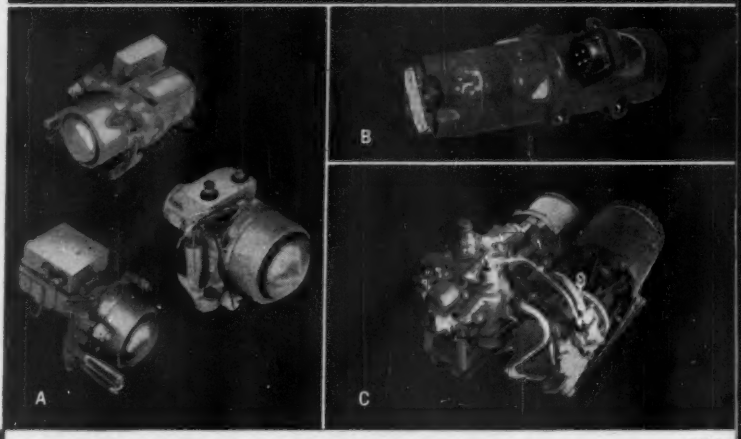

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George Meyer, vice president-manufacturing, Parker Seal Co., a division of Parker-Hannifin Corp., Berea, Ky.

Sam J. Farmer, vice president and counsel, General Atomic Division of General Dynamics Corp., San Diego, Calif.

Robert Keith Gray, formerly secretary of President Eisenhower's Cabinet, a vice president of Hill and Knowlton, Inc., Washington, D. C., succeeding **Avery McBee** appointed to the New York headquarters.

Dr. Harold Lyons, a vice president, Electro-Optical Systems, Inc., Pasadena, Calif. Dr. Lyons will manage the company's newly formed Quantum Electronics Division.

Paris H. Stafford, vice president-engineering, Permanent Filter Corp., Los Angeles, Calif., and **Marvin M. Harvey**, director of manufacturing.

Avco Corp.'s Lycoming Division has appointed the following vice presidents for the Williamsport (Pa.) operation: **John M. Ferris**-sales; **C. H. Buddenbaum**-manufacturing; **P. J. Goodwin**-controller; **C. H. Wiegman**-engineering.

David J. McFarland, vice president-traffic and sales, Trans Caribbean Airways. Named assistant vice presidents: **Walter J. Gromel**-operations; **John F. Peterson**-maintenance and engineering.

Robert F. Stewart, vice president-marketing, Gabriel Electronics, a division of The Gabriel Co., Millis, Mass.

William H. Rous, vice president-international operations, Amphenol-Borg Electronics Corp., Broadview, Ill.

The Borden Chemical Co., New York, N. Y., has formed three new divisions and appointed the following as vice presidents in charge: **Raymond J. Lodge**, Adhesives & Chemicals Division; **Ray T. Hanson**, Western Operations Division; **Harry C. Wechsler**, Thermoplastics Division.

William W. Baker, controller, Space and Information Systems Division, North American Aviation, Downey, Calif. Also: **R. J. Armitage**, director of logistics; **Kenneth B. Gay**, director of material.

John L. Grabber, corporate secretary and contracts and legal counsel, Fairchild Engine and Airplane Corp., Hagerstown, Md.

Honors and Elections

C. R. Smith, president of American Airlines, has been selected by Aviators' Post #743 of the American Legion to receive the 1961 award as the United States citizen making an outstanding individual contribution to aviation progress.

Stuart L. Bailey, president of Jansky & Bailey, has been elected treasurer of the Institute of Radio Engineers succeeding the late **Dr. W. R. G. Baker** of General Electric.

INDUSTRY OBSERVER

► First attempt to restart the engine of the Lockheed Agena B second stage in space is planned for the Discoverer XX flight. The Bell engine has been restarted in Arnold Engineering Development Center facilities under simulated space conditions, but never in space.

► **Air Force is considering a land recovery technique for the E-6 advanced capsule in the Samos reconnaissance satellite system. Alternatives include recovery by parachute alone and by partial glide, terminating in a final letdown by parachute. Samos ultimately is to be capable of transmitting pictures directly from orbit, eliminating the recovery requirement.**

► Minuteman test vehicle is programed to fly 4,000 mi. in its first flight, scheduled this week at Atlantic Missile Range.

► **Modification of the Atlas booster to be used with Mercury capsules will involve use of heavier gage rolled steel for the upper portion of the airframe. Atlases launching Samos and Midas satellites also will have this stronger upper section.**

► Design engineering inspection of the USAF-Martin Titan II missile and basing and support systems will be held in Denver Jan. 31, using a full scale mockup of the missile.

► **Inertia wheel concept is being considered for Samos stabilization as an alternate approach to the reaction jet system for long duration control of the satellite to keep its nose pointed toward the earth for reconnaissance.**

► Spread-spectrum technique, transmitting signals over a wide range of frequencies, will be used to minimize the possibility of jamming the earth-current radio system which will control firing of Minuteman ICBMs from silos. Air Force plans to continue development of earth-current communications, and the Command and Control Development Division recently issued requests for industry proposals. Rome Air Development Center will manage the project.

► **Reliability analysis of the Saturn space booster, made by Arinc Research Corp. for National Aeronautics and Space Administration, indicates the first-stage vehicle's intrinsic reliability should be high, discounting possible bugs inherent in any new design. Arinc reported to NASA last week on the analysis.**

► Apollo spacecraft will weigh between 15,000 and 20,000 lb. National Aeronautics and Space Administration will launch the vehicle on earth orbit missions with the three-stage Saturn C-1 and on cislunar missions with the four-stage Saturn C-2.

► **Office of the Director of Defense Research and Engineering has asked 60 top U. S. electronics scientists and businessmen to indicate the most important areas of electronics research which should be supported by Defense Department in the next several years. The list includes Dr. Jerome B. Wiesner, new White House scientific adviser.**

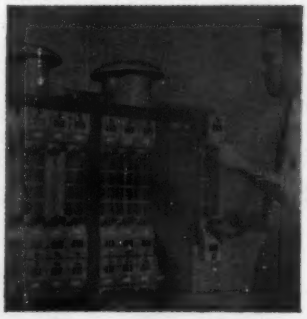
► Hot runs of the Pratt & Whitney LR-115 liquid hydrogen engine are scheduled within the next few weeks at Convair-Astronautics Sycamore Canyon static test facility, following successful cold-flow tests. The cold-flow runs, made with the engine complete with tankage and plumbing, lasted 15 to 30 sec.

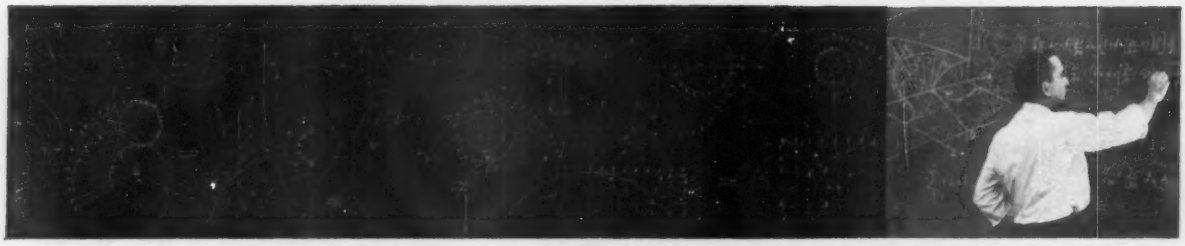
► **Project Mercury tracking station at Bermuda is being instrumented as the backup control center for orbital flights. It will have the same equipment and displays as the primary control station at Cape Canaveral.**

► Project Mercury recovery force will consist of 20 destroyer-type ships and 40 aircraft spread over the nine planned recovery areas in the Atlantic Ocean. Because of the low probability of the capsule landing outside a planned area, an additional emergency recovery force will be small and will duplicate the air-sea rescue plan for transatlantic presidential flights.

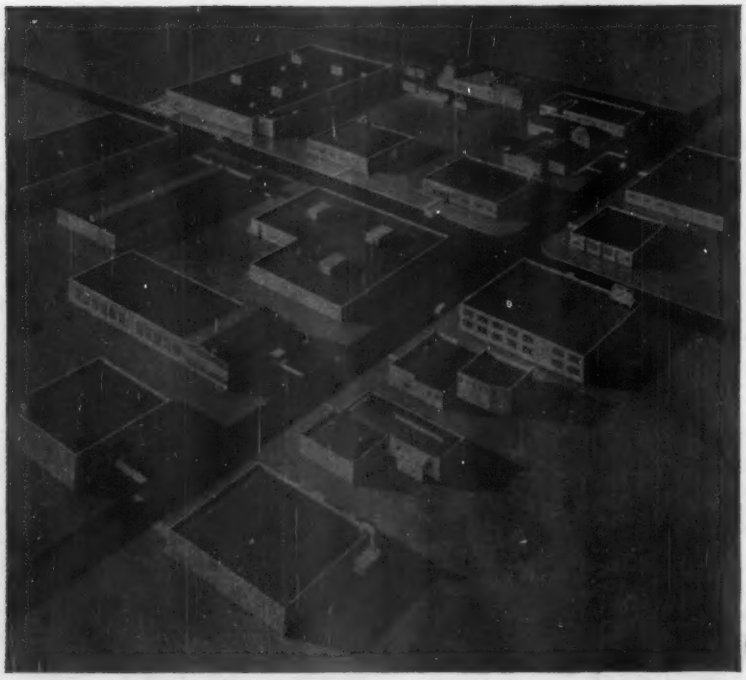
LIBRASCOPE COMPUTER FACILITIES

Shown below is a composite view of Librascope's facilities where a variety of computer systems are currently in different stages of design and production. Some are strategically involved with national defense...others deal with business and industrial process control. Each is uniquely designed to answer a particular need. The success of these systems illustrates the value of Librascope's engineering philosophy: A decentralized organization of specialized project teams responsible for assignments from concept to delivery...and backed up by excellent research, service, and production facilities. For your computer requirements, call on the company whose breadth of diversification in computer technology is unsurpassed. ■ Librascope Division, General Precision, Inc., 808 Western Avenue, Glendale, Calif. For career opportunities write to John Schmidt, Engineering Employment. ■





computers that pace man's expanding mind



Washington Roundup

Chief Candidates

Contest for chief and vice chief of staff of the Air Force is still far from settled, but speculation is strong that Lt. Gen. Bernard A. Schriever will be vice chief before the year is out. Schriever's Air Research and Development Command is the main drive behind Air Force's attempts to build a larger space program, but Schriever also has been careful to re-emphasize the importance of manned aircraft.

Air Force Space Study Committee (see p. 33) named by Schriever to survey the present and future potential of space efforts, is to some degree a counterpart of the Wiesner task force that prepared a report for President Kennedy, and it has Dr. Jerome Wiesner, the new White House Science adviser, as a key member.

Speculation is that Lt. Gen. Frederic Smith, USAFE commander, may move into the vice chief's job before Gen. Thomas D. White leaves as chief—then move up, with Schriever becoming vice chief. Gen. Thomas Power of Strategic Air Command also continues to be mentioned for the top job, but either way, Schriever appears to be the front runner for the number two spot. His close friendship with Vice President Lyndon Johnson may be a deciding factor when the choices are made.

Nuclear propulsion projects may be in for rapid acceleration under the new administration. This probably will even include the pursuit of both approaches to a nuclear aircraft engine. Although judicious decisions will have to be made on what is to be funded, the appointments to official posts and membership of important advisory groups reflect a far greater familiarity with nuclear energy than government jobholders in the past few years have had.

More Defense Money

An additional $2 billion in defense funds, probably split between a supplemental request for Fiscal 1961 and an amendment to the Fiscal 1962 Eisenhower budget, is expected to be requested from Congress by the Kennedy Administration.

Military services last week turned over shopping lists to Deputy Defense Secretary Roswell Gilpatric. These will form the basis for the money requests. The services were told to concern themselves primarily with need rather than cost. Watch for increase in operations and maintenance money, where cuts are being blamed for increased aircraft accident rates in both Navy and Air Force.

Gradual reduction of flight pay for military pilots removed from flight status, which was recommended by President Eisenhower in his budget message, will have tough sledding on Capitol Hill. Both there and among non-pilots within the services there is little sympathy for the pilots. The situation is aggravated in the Air Force by the large numbers of pilots who have little other technical or administrative training, making it hard to find non-flying jobs for them.

Air Union, the proposed consortium of Air France, Alitalia, Lufthansa and Sabena, is being revived after a long period of disagreement on basic issues which led many observers to think the project was dead. All these flag lines except Germany's Lufthansa have been ordered by their governments to resume talks.

Air Force will attempt to fly a Boeing B-52 12,390 naut. mi. from Yakota AFB, Japan to Torrejon AFB, Spain via Oklahoma City to beat the straight line record set by Navy's Lockheed P2V-1, the Truculent Turtle, on a 10,625-naut.-mi. flight from Perth, Australia to Columbus, Ohio, Sept. 29-Oct. 1, 1946.

NASA Uneasy

Delay in naming a new National Aeronautics and Space Administration chief has convinced the agency that it has already lost much of its status (see p. 33). Many of the top staff question their futures in view of the Wiesner report's criticism of NASA management. NASA Administrator Keith Glennan was the first Eisenhower appointee to resign—on Dec. 28—and a quick decision on a successor would have assured NASA an effective voice in the early days of the new administration.

Chairman Richard Russell will name a Senate Armed Services Subcommittee to update the 88-year old conflict of interest law affecting government appointees.

Congress may act on the renegotiation law this year, although it doesn't expire until mid-1962, because next year will be a busy election year. Joint Internal Revenue Taxation Committee must submit recommendations by Apr. 1. Aerospace Industries Assn. will urge putting the law on a year-to-year basis if it is to be continued, and will urge relocation of the now-independent Renegotiation Board in the Defense Department.

Expect Sen. Mike Monroney to reintroduce a bill authorizing government guaranteed loans for the purchase of cargo aircraft. Similar bill died in the last session.

—Washington Staff

Defense Budget of $41.8 Billion Asked

Eisenhower plan calls for $532 million increase; Kennedy's amendments expected in next few months.

By Larry Booda

Washington—Eisenhower Administration last week asked Congress for $41.84 billion in new Defense Department funds under a budget that is expected to be amended considerably by the Kennedy Administration in the next few months. The request is for $532 million more than Congress appropriated last year.

Actual spending under the Eisenhower defense budget for Fiscal 1962, exclusive of military assistance to other countries, is estimated to be $42.9 billion, an increase of $1.4 billion over the estimated expenditures for the current fiscal year. This is the highest figure since World War II with the exception of Fiscal 1953, which was only $800 million higher.

Fiscal 1962 money that would be committed for spending is estimated at $43.42 billion, a decrease of $628 million from the figure for the current fiscal year.

Balanced Budget

President Eisenhower requested a total national budget of $80.9 billion for Fiscal 1962, estimating that the Fiscal 1961 budget would be narrowly in balance by $100 million and that his budget for Fiscal 1962 would produce a surplus of $1.5 billion.

New money requested for the Defense Department is divided $17.9 billion for Air Force, $12.2 billion for Navy, $10.4 billion for Army and $1.4 billion for the Office of the Secretary of Defense.

Both new money requested and actual spending expected will increase very slightly for missiles. Aircraft spending will be slightly higher than last year, but new obligational authority will be lower than Fiscal 1961 by $397 million. Both Air Force and Navy's active aircraft inventories will decrease, while the Army's will increase. Manpower level remains at 2,492,000 people.

President Eisenhower said that major emphasis was being placed on the Navy's Polaris submarine-launched ballistic missile, the Air Force's Minuteman solid propellant intercontinental missile, the Air Force's B-70 supersonic bomber and on airborne alert, and Army and airlift modernization.

Chief criticism from the military services, aside from that of receiving less than they requested, is that personnel and materiel costs have increased about 3.5% per year while new money requested for these categories for Fiscal 1962 represents an increase of only 1.3% over Fiscal 1961.

Cost Squeeze

This trend has been going on since the end of the Korean War and is causing a financial squeeze, officials say. The answer, they say, is to stop making cuts across the board in a number of programs and to eliminate some entire programs instead. The budget document itself takes note of increased operating costs by pointing out that the cost per hour of flying a Republic F-105 fighter-bomber is almost three times that of the North American F-100.

The Eisenhower budget provides no new money for development of the Navy-Douglas Missileer aircraft or the USAF-Douglas Skybolt air-launched ballistic missile. Fiscal 1961 money has been spread over both Fiscal 1961 and Fiscal 1962 for both projects, leaving it to the Kennedy Administration to decide whether they shall be given additional funding from an amended Fiscal 1962 budget. Kennedy is left with a similar situation on Aircraft Nuclear Propulsion program (see p. 28).

Defense Department began last year to shift money that actually supported research and development out of the procurement category and into a new category called research, development, test and evaluation. It had hoped to complete the transfers this year, but this has not been done for USAF's ballistic missiles, the B-70, the new cargo aircraft for the Military Air Transport Service and for some Navy aircraft development.

New money requested for procurement of all types is $13.378 billion, a decrease of $75 million from the previous year. New money that will be obligated is estimated at $14.641 billion, down $652 million from Fiscal 1961. Procurement expenditures are expected to be $14.372 billion, up $619 million from last year.

Aircraft-Missile Strength

	Actual	Planned	
	June 30, 1960	June 30, 1961	June 30, 1962
Air Force			
Combat Wings	96	88	84
Strategic Wings	40	37	34
Air Defense Wings	23	19	19
Tactical Wings	33	32	31
Combat Support Flying Forces	117	111	107
Air Refueling Squadrons	62	65	63
MATS Air Transport Squadrons	22	21	19
Other Specialized Squadrons	33	25	25
Active Aircraft Inventory	18,712	16,941	16,080
Navy			
Polaris Submarines	.....	5	9
Carrier Air Groups	16	16*	16*
Carrier Anti-submarine Squadrons	11	11	11
Patrol and Warning Squadrons	41	38	37
Marine Air Wings	3	3	3
Active Aircraft Inventory	8,863	8,768	8,401
Army			
Anti-aircraft Missile Battalions	80¼	77¼	67¼
Surface-to-Surface Missile Battalions	24	26	29
Active Aircraft Inventory	5,493	5,657	5,736
Helicopters	2,633	2,774	2,841
Fixed-Wing	2,860	2,883	2,895

* Plus temporary attack force increase.

Major Military Obligations and Expenditures

(Millions of dollars)

	N.O.A.* FY 1960	Direct obligations	Expend. FY 1960 (Actual)	N.O.A. FY 1961	Direct obligations	Expend. FY 1961 (Est.)	N.O.A. FY 1962	Direct obligations	Expend. FY 1962 (Est.)
Air Force									
Aircraft	4,285	3,405	4,629	3,562	4,615	4,021	3,197	3,687	4,183
Missiles	2,466	2,591	2,785	2,615	2,833	3,049	2,811	2,886	3,007
Research, Development, Test and Evaluation	1,468	1,392	1,370	1,559	1,761	1,398	1,637	1,667	1,618
Operation and Maintenance	4,344	4,316	4,275	4,504	4,506	4,445	4,533	4,533	4,475
Navy									
Aircraft	1,739	1,840	1,765	1,612	1,877	1,743	1,527	1,770	1,756
Ships	1,135	1,473	1,744	2,246	1,866	1,674	1,825	2,074	1,695
Missiles	382	427	423	553	619	427	498	566	491
Research, Development, Test and Evaluation	1,312	1,298	1,129	1,299	1,356	1,363	1,267	1,253	1,315
Operation and Maintenance	2,684	2,665	2,664	2,773	2,773	2,579	2,803	2,803	2,722
Army									
Aircraft	100	152	93	119	163	133	172	177	156
Missiles	392	455	583	351	446	421	507	519	507
Research, Development, Test and Evaluation	1,102	1,072	1,021	1,095	1,159	1,064	1,130	1,130	1,102
Operation and Maintenance	3,235	3,221	3,246	3,379	3,391	3,323	3,435	3,435	3,404

* New Obligational Authority

President Eisenhower asked Congress to appropriate the entire defense budget to the Secretary of Defense, rather than to the three services, an idea also recommended in the defense reorganization plan prepared for President Kennedy by a group headed by Sen. Stuart Symington (D.-Mo.).

Congress, however, jealously guards its somewhat specific control over service appropriations and is expected to pay no attention to this request. The secretary already has transfer authority over a $150-million appropriation to his office; a $150-million emergency fund; a $150-million missile fund and authority to transfer money from any service account into the Advanced Research Projects Agency, and back to any other service account.

Military Expectations

The services expect to buy a total of 1,420 aircraft in Fiscal 1962, including 644 for Navy, 515 for USAF and 261 for Army. The Army will initiate development of a new surveillance aircraft, and USAF will undertake development of the CX-1 jet cargo transport, which actually is being initiated with Fiscal 1961 money.

For budget details on procurement of aircraft, missiles and ships, on research, development, test and evaluation, and on operation and maintenance, see the accompanying table.

Highlights of the USAF program are:

• **Martin Titan** intercontinental missile is USAF's biggest program. In the largest of four different budget requests which the services submitted to Defense Department—a budget with a total 10% above last year's—USAF asked $853 million for Titan. The Administration instead requested $1.154 billion.

• **Minuteman** solid propellant ICBM is programed for $917 million. USAF asked $1.079 billion in the largest of its requests.

• **Skybolt funding** of $80 million in the Fiscal 1961 budget has been increased by a reprograming that adds another $70 million, also in 1961 money.

• **Convair Atlas** ICBM will get $201 million, which essentially will cover procurement for 13 squadrons.

• **Airlift modernization** will total $194 million, including $34 million for the straight cargo version of the Lockheed C-130B, $70 million for the assault cargo version, $7 million for RC-130s, and $98 million for the CX-1.

• **North American B-70** development will cost $354 million. First flight test is due in 1963. B-70 funds through Fiscal 1961 had totaled close to $800 million, including $265 million in Fiscal 1961 itself.

• **Seventy-two Boeing KC-135** tankers will be bought at $185 million. A request for six electronics countermeasures trainer versions of the C-135 was denied.

• **Total of $397 million** will go for Republic F-105s—$370 million for 192 fighter-bombers and $27 million for reconnaissance versions.

• **Northrop T-38** will receive $128 million, the North American T-39 will get $50 million and the Lockheed T-40 (JetStar) $19 million.

• **Aircraft modification** will require $637 million, and replenishment spares will take $875 million.

• **Space funds** include $276 million for the Samos photographic reconnaissance satellite and $141 million for the Midas infrared early warning satellite.

Defense's budget for Fiscal 1961 included approximately $150 million for spares on the shelf to keep one-eighth of Strategic Air Command's B-52 bombers on a compromise airborne alert status. The new budget includes funds to buy spare parts for the Hound Dog missile, which has to exercise engines and keep electronic equipment in operation as part of the alert operation, and money for additional indoctrination training made necessary for the alert. Total for both years for airborne alert is estimated at $350 million. USAF has not yet achieved the objective of preparing one-eighth of the B-52 heavy bomber force to go on airborne alert on short notice.

Navy Program

Highlights of the Navy program are:

• **Procurement of 644 aircraft** with a total of $1.527 billion. Production will continue on the North American A3J heavy attack bomber, the Douglas A4D-2N and A4D-5 light attack aircraft, and the Grumman A2F low-level attack aircraft. Money for the McDonnell F4H fighter, funded at $255 million in Fiscal 1961, will be increased, as will funds for the Grumman W2F early warning carrier aircraft, now funded at $56 million. New money also includes the Lockheed P3V, Sikorsky HSS-2, Kaman HU2K-1 and Lockheed

GV-1 assault transport for Marines.

• **Lockheed Polaris** will continue at a high level, with $1.5 billion going into the whole program. Navy's shipbuilding money includes funds for five more Polaris submarines, for a total of 19, and leadtime money is included for another five Polaris subs.

• **Program of 30 new ships** includes 16 whose primary mission is anti-submarine warfare. The 16 include three nuclear subs, seven guided missile frigates and six escorts. Conversions include 16 destroyers and six subs.

• **Electronic systems** for shipboard and aircraft will increase as Navy's Tactical Data System nears readiness for installation.

Army program highlights:

• **Purchase of 261 aircraft** is evenly divided between helicopters and fixed-wing types. Purchase of Grumman AO-1 Mohawk combat surveillance aircraft will be greater than the 54 in Fiscal 1961. Army will buy more de Havilland Caribou STOL transports, and more Vertol YHC-1 and Bell HU-1 helicopters.

• **Funds for Nike Zeus** anti-missile-missile development in this budget will carry the development cost beyond $1 billion. No preproduction money is included in the new budget, although Army had requested it. Funds obligated for this program through Jan. 1 of this year had totaled $790.6 million, with $85 million left to be obligated from Fiscal 1961 funds.

• **Progress of Army modernization** is reflected in procurement funds, which increase $300 million in new money requested, $200 million in expected obligations, $300 million in estimated expenditures.

• **Davy Crockett** field atomic missile will go into production.

Eisenhower Urges Single Nuclear Engine

Washington—President Eisenhower brought to a head the long argument over a dual approach to a nuclear aircraft engine last week by requesting a sharply reduced appropriation for Fiscal 1962 and urging that the program be continued "on one technical approach."

This brought immediate protests from several Congressmen on the grounds that a proper technical selection between the General Electric direct cycle and the Pratt & Whitney indirect cycle cannot be made at this point in their development.

Spending for the Aircraft Nuclear Propulsion program has been running about $150 million a year in recent years—half of it in Air Force funds and half in the Atomic Energy budget. Each agency wanted $75 million for Fiscal 1962, but the budget forwarded to Congress requests only $35 million for Air Force and $33 million for AEC.

Rep. Melvin Price (D-Ill.), chairman of the Joint Atomic Energy Committee's research and development subcommittee, called the Eisenhower decision "arbitrary" and an example of "the handicap under which much of our vital research and development work is conducted. The continual changes in effort and changes in plans for carrying out our work result in waste and delays in completing projects."

Price said the ANP program "has been plagued with indecision and a great deal of irresponsible interference by a myriad of government evaluation and review boards."

"In spite of these externally induced interferences, the AEC personnel responsible for carrying out the program and their contractors have finally gotten together a sound program for proceeding with the final phases of the work," Price said.

"Now it appears that the outgoing administration has suddenly obtained sufficient technical experimental data on the approaches to the solution of the problem to permit the selection of the 'best approach'!"

Price said his subcommittee certainly will ask for this data "if it exists." He noted that the selection apparently had not yet been made, and said "if there is to be a grain of rationality in the decision-reaching process, the determination of the best approach should precede the preparation of (the Fiscal 1962) budget."

Rep. Emilio Q. Daddario (D.-Conn.) said neither program should be abandoned until "a clear superiority is established."

The House Armed Services Committee last spring asked the Defense Department to decide by September on one engine and develop only that one. Price last week released a letter written to him for outgoing Defense Secretary Thomas Gates by Courtland D. Perkins, assistant USAF secretary for R&D, in which Perkins said:

". . . It is the position of the Air Force that an additional period of experimentation and engineering effort will yet be required before such a decision can be made with an acceptable degree of technical confidence. The Air Force hopes that budgetary problems will not force an early and therefore risky cycle selection." The letter was dated Jan. 4 of this year—long after the 1962 budget was made—and was in reply to a Price letter to Gates of last Nov. 16.

SAC Plugging Skybolt

Omaha—Strategic Air Command's insistence that it needs the Douglas Skybolt air-launched ballistic missile for its strike capability may save the sagging program and result in Fiscal 1962 funding after a review by the new administration.

Top-level officers from SAC and the Wright Air Development Division spent three days last week at Douglas Aircraft Co. making a careful economic and development analysis of the project.

British personnel stationed at Defense Department and at WADD also were at Douglas to formulate a separate pricing work statement for Skybolt's adaptation to the Vulcan bomber.

Britain would prefer to fund the Skybolt-Vulcan work separately. Meanwhile, Skybolt development items peculiar to the Vulcan continue to be engineered at Douglas while items common to both Vulcan and the Boeing B-52 are being affected by the stretchout in Fiscal 1961 funds **(see p. 26).**

AEC Budget

Washington—Atomic Energy Commission expects to obligate more money for naval propulsion, the Rover nuclear rocket program, the Pluto nuclear ramjet program and the Snap auxiliary nuclear power program in Fiscal 1962 than it did in Fiscal 1961, but increases in these and in civilian reactor development are more than offset by a cut in the Aircraft Nuclear Propulsion program (ANP).

Rover funds would increase from $23.23 million to $29.99 million, Pluto funds from $20.07 million to $20.51 million, Snap funds from $15.08 million to $19 million and naval reactor funds from $87.5 million to $94.7 million under the budget requested from Congress last week.

ANP would drop from $72.62 million to $33 million, requiring elimination of one engine development program. Construction fund requests include an unspecified amount of money for development and test facilities for ANP.

AEC asked $590.2 million for weapons development and production, an increase of $66.2 million, and $26.5 million for research on controlled thermonuclear reactions under Project Sherwood, a decrease of $4.6 million.

NASA Budget Cautious on Man-in-Space

By Edward H. Kolcum

Washington—Congress was asked last week to appropriate $1.17 billion for a National Aeronautics and Space Administration program which puts heavy emphasis on booster and communications satellite development, but reflects a newly cautious attitude toward second-generation manned spacecraft.

President Eisenhower requested $1,119,630,000 for Fiscal 1962 and $49,606,000 to supplement the $915 million Fiscal 1961 budget. President John F. Kennedy, inaugurated late last week, is expected to change the Eisenhower budget in the coming months to reflect his administration's philosophy on the U. S. space effort.

Nearly a quarter of the Fiscal 1962 request is programed to support the Saturn program. NASA expects fiscal requirements for Saturn development to peak in the coming fiscal year.

Requests for communications satellite programs total $68.6 million, including $24 million in supplemental funds to launch the Relay active-repeater satellite program and expand the passive satellite effort. About two-thirds of the supplemental is for development of Relay (see p. 30).

Apollo Cutback

The $29.5 million request for Apollo reflects a conservative Eisenhower Administration approach to the manned space flight program. Rather than gamble on the feasibility of the multi-man spacecraft by contracting for prototype Apollo hardware in Fiscal 1962 as originally was planned, President Eisenhower set the stage for a more modest program in his budget message.

Discussing manned space flight, he said, "Further testing and experimentation will be necessary to establish whether there are any valid scientific reasons for extending manned space flight beyond the Mercury program."

Apollo flight testing will be limited largely to re-entry model studies.

About half the Apollo funds will go toward purchase of launch vehicles, leaving $15 million for prototype design and development studies. Apollo funding was cut from a request for $35 million plus the cost of boosters. Fiscal 1961 Apollo money totals $1 million, reduced from an original $23 million request.

Pure aeronautical research will continue at a comparatively low level, with the effort estimated at between $27.5 and $33 million. Although much of the agency's materials, structures and mechanics research is applicable to aircraft as well as missiles and space vehicles, NASA's emphasis on space was criticized in the Wiesner group report (AW Jan. 16, p. 26). NASA feels the level of its aeronautical research effort is well above military and civil demands.

NASA is putting about half as much effort on aeronautical research as its predecessor agency, National Advisory Committee for Aeronautics, during its peak years.

Maturing Programs

NASA's research and development estimate of nearly $830 million indicates a number of programs have matured from design to hardware status, particularly in the categories of planetary spacecraft and meteorological and communications satellites. Only two of the 23 program categories show decreases: Mercury, which reached its peak funding this year, drops from $109.5 million to $74.2 million; Delta funding drops to $2.9 million from $11.8 million, and this vehicle will be phased out of the booster inventory in Fiscal 1962. Program funding in all categories includes cost of launch vehicles.

Approximately 67% of the research budget will go directly from NASA to industry in contracts. Another 18% will go through Defense Department to industry, and 15% will be spent in-house.

The Saturn program totals about $250 million in Fiscal 1962 estimates, including direct research and development funds of $168 million, plus portions of salaries and expenses at Marshall Space Flight Center, construc-

National Aeronautics and Space Administration
Fiscal 1959-62 Budgets

	FY 1959	FY 1960	FY 1961	FY 1961 Supplemental Request	FY 1962 Request
Research and Development	$204,619,532	$333,100,000	$617,915,000	$49,606,000	$829,819,000
Salaries and Expenses	85,286,300	90,850,000	170,760,000	.....	189,986,000
Construction and Facilities	48,000,000	99,625,000	126,325,000	.....	99,825,000
Total	$338,905,832	$523,575,000	$915,000,000	$49,606,000	$1,119,630,000
Number of employes	9,386	10,286	16,493		17,342

Research and Development Budget

	Fiscal Year 1960	Fiscal Year 1961	Fiscal Year 1961 Supplemental Request	Fiscal Year 1962 Request
Support of NASA plant	$27,761,897	$48,703,000	.....	$74,310,000
Research grants and contracts	4,869,370	5,000,000	.....	7,600,000
Life sciences	.....	5,000,000	.....	8,620,000
Sounding rockets	9,681,000	8,170,000	.....	7,000,000
Scientific satellites	20,241,114	37,942,000	.....	64,700,000
Lunar and planetary exploration	49,995,900	77,524,000	$5,000,000	103,899,000
Meteorological satellites	7,930,000	18,100,000	.....	28,200,000
Communication satellites	3,850,000	3,912,000	24,000,000	44,600,000
Mercury	84,328,370	109,325,000	.....	74,245,000
Apollo	100,000	1,000,000	.....	29,500,000
Launch vehicle technology	.....	9,100,000	.....	15,000,000
Launch operations development	.....	100,000	.....	9,500,000
Spacecraft technology	4,019,349	7,875,000	.....	10,360,000
Solid propulsion	1,720,000	1,300,000	.....	3,100,000
Liquid propulsion	27,217,000	57,000,000	.....	68,700,000
Electric propulsion	1,300,000	3,300,000	.....	6,800,000
Nuclear systems technology	5,613,000	10,000,000	2,600,000	24,000,000
Space power technology	3,514,000	4,700,000	.....	5,500,000
Scout	3,000,000	2,150,000	1,825,000	3,675,000
Delta	12,475,797	11,800,000	.....	2,900,000
Centaur	36,644,203	47,000,000	16,181,000	30,800,000
Saturn	9,450,000	118,058,000	.....	168,160,000
Vega	4,000,000	.....	.....	.....
Tracking and data acquisition	16,189,000	31,656,000	.....	38,650,000
Total	$333,100,000	$617,915,000	$49,606,000	$829,819,000
Transferred to construction of facilities	+15,000,000	+3,538,000	.....	.....
Transferred from salaries and expenses	−550,000	.....	.....	.....
Anticipated reimbursements from non-federal sources	.....	.....	.....	−10,000,000
Total appropriations	$347,550,000	$621,453,000	$49,606,000	$819,819,000

tion at Marshall and the Atlantic Missile Range, and research within NASA which support Saturn. Saturn funding began in Fiscal 1959 with $34 million, rose to $70 million in Fiscal 1960 and $230 million this year.

In addition to the $24 million for communications satellite development in the Fiscal 1961 supplemental, this request includes $16.2 million to increase the number of Centaur development flights from eight to 10 vehicles, $5 million to begin development of long leadtime items for the Mariner spacecraft and $1.8 million to increase Scout development flights from six to eight and to improve Scout upper stage capability so that it can carry 200 lb. into orbit (AW Dec. 12, p. 33).

The supplemental also contains $2.6 million to initiate design for the Rover nuclear engine (AW Dec. 26, p. 15), laying the groundwork for a hardware contract during the coming fiscal year.

Congress voted NASA a $50-million research emergency fund last year in addition to the regular Fiscal 1961 budget, and the agency plans to use this money to cover its Fiscal 1961 supplemental request. The money can be made available quickly, since approval of the Senate and House space committees is all that is required to release it.

Regular budget requests include $74.3 million for support of the NASA plant, increased $26 million in Fiscal 1962 to reflect NASA support for the Dyna-Soar program and purchase of research rockets and test flight equipment. NASA is responsible for instrumenting the Dyna-Soar vehicle.

Research grants and contracts and life sciences budgets, spent with universities and scientific laboratories, total $16.2 million, an increase of about $6 million over the current year.

Space sciences category includes requests for $175.6 million, mostly for lunar and planetary exploration. Requests cover Ranger costs, plus the Surveyor contract expected to be awarded within several months. Scientific satellites are funded at $64.7 million, with about 75% of this amount set aside for development of the astronomical, geophysical and solar observatory spacecraft and related instrumentation.

Applications satellites include $28.2 million for meteorology, primarily for the second-generation Nimbus plus a small amount for the third and final Tiros. There is no money included for third-generation Aeros weather satellite development.

Advanced technology development projects are funded at $29.9 million, including $15 million for launch vehicles, up $5.9 million; $9.5 million for launch operations compared with $100,000 this year, and spacecraft increased to $10.4 million from $7.9 million in Fiscal 1961.

Launch vehicles program covers funding for background study of future vehicle concepts, including Nova and the improved Saturn, along with research hardware for these studies. Launch operations and spacecraft technology funds likewise are aimed at refining launch methods, instrumentation and payload packages.

Propulsion programs include $3.1 million for solids, a $1.8-million increase; $68.7 for liquids, up $11.7 million, and $6.8 million for electric propulsion, an increase of $3.5 million.

Solid rocket program does not envision any single major development, but rather is funded to continue feasibility studies of large and small boosters and segmented configurations. Liquid rocket budget will continue development of the F-1 engine and the 200,000 lb. thrust liquid hydrogen engine. Electric propulsion research includes ion, arc jet and magnetohydrodynamics.

The $24 million for nuclear propulsion is increased $14 million from the current year, with $9.6 million for SNAP, $7.5 million for Rover, and the remainder to support Atomic Energy Commission reactor development and NASA work on non-nuclear rocket components.

Space power technology is budgeted at $5.5 million, a $1.3 million increase, for continued work on Sunflower and possibly a new solar collecting device.

Operation of the tracking and data acquisition net, plus completion of communications for Mercury and completion of the South African deep space tracking station, is budgeted at $38.6 million, an increase of $7 million.

The $99.8 million construction and facilities program, employment levels and the salaries and expenses requests for NASA installations include:

- **Langley Research Center:** $3.99 million for facilities to determine structural properties in a hard vacuum and equipment to determine space uses and properties of plasmas. Employment level remains at 3,220; salaries and expenses are estimated at $31.5 million.
- **Ames Research Center:** $6.4 million for a hypervelocity free flight research facility, plus modifications to accommodate the life sciences station (AW Jan. 16, p. 26). Employment stays at 1,437;

NASA Communication Satellite Effort Grows

Washington—Commercial communications satellite development has emerged as the fastest growing project in the National Aeronautics and Space Administration's program as increased spending is planned to develop active and passive systems.

NASA has asked Congress for $68.6 million to support the program, with about $50 million earmarked to explore problems of a commercially-adaptable active-repeater. NASA plans to initiate this program at an industry briefing Jan. 24-25 at Goddard Space Flight Center (AW Jan. 9, p. 33).

Proposed budget will allow NASA to go ahead with a four-shot active program, called Relay, and a series of ballistic flights of a passive satellite more rigid than Echo. Passive program, called Rebound, will use a 140-ft. sphere in ejection tests like the Shot Put series which preceded Echo. Development could extend to tests of ejecting as many as six spheres from a single package.

NASA has scheduled two Delta and two Atlas Agena B vehicles for its active satellite development program, but the first Delta will not be available until about May, 1962. Vehicle availability governs the launching schedule.

At its Relay meeting, NASA will request bidders' proposals by Mar. 6, under these specifications:

- **Satellite package: Five to be supplied, two for flight, one a flight spare, one a prototype and the fifth a structural model. Contractor will supply special test equipment and dummy electronics for the structure model. Maximum payload weight is 85 lb. including electronics. Satellite is to be 50.25-in. high with a bottom diameter of 29 in. and the body will narrow to a 10-in. diameter at a point 16.25 in. from the bottom.**
- **Frequencies from ground to satellite will be in the 400-500 mc. band; from satellite to ground, 2,200-2,300 mc. Satellite will transmit video, CW and other data, with principal ground stations on the East Coast and in western Europe, probably Great Britain. Video band width is 30 mc. at 6 db., with attenuation at 2 mc. no more than 2 db.**
- **Orbit path will be elliptical, 2,500-mi.-3,000-mi. apogee and 600-mi.-1,400-mi. perigee. Inclination will range from 30-55 deg., with 180-min. period.**
- **Experiment will include the wide band communications equipment, plus instruments to measure the effects of radiation and the space environment on critical components such as solar cells.**

Specifications emphasize the research nature of the project, which is expected to provide basic information for commercially-developed active communications systems. NASA has included a $10-million estimate of industry participation in its budget, reflecting current government encouragement of industry-financed communication satellites. The estimate anticipates possible launch vehicle and launch services charges to put commercially financed systems in orbit.

salaries and expenses are budgeted at $16.1 million.

• **Lewis Research Center:** $3.6 million for a heat transfer facility, plus modifications to the space environment tank. Work force at Lewis is to increase by 13 employes to a total of 2,754; salaries and expenses are to total $27.8 million.

• **Flight Research Center:** No construction. Employment is to rise 75 to a total of 494 to support the Dyna-Soar program. Salaries and expenses are estimated at $4.3 million.

• **Goddard Space Flight Center:** $9.2 million for an environmental testing center, advanced data processing facility and isolation laboratory. Employment is to increase 600 to a total of 2,598, including the Space Task Group. Salaries and expenses are budgeted at $35 million. The 600-man Space Task Group was separated from Goddard after the budget was printed.

• **Wallops Station:** $6.3 million for improved tracking facilities, vehicle dynamic balance equipment and safety system modifications. Employment level stays at 299; salaries and expenses are to total $3.1 million.

• **Marshall Space Flight Center:** $8.9 million for a high vacuum test facility and technical service building, liquid hydrogen static test area, liquid oxygen storage facility, plus extension of blockhouse, engineering building, structural test building and utilities. Employment is to decrease by 11 persons to 5,500; salaries, expenses are at $61.1 million.

• **Jet Propulsion Laboratory:** $3.6 million for various laboratory modifications, utilities extension, additions to spacecraft assembly building and microwave range. Plant support is funded in program activities.

• **Atlantic Missile Range:** $32.6 million to complete the Saturn complex, modify a complex to accommodate Centaur, construct an additional Saturn barge, construct a central shop, spacecraft assembly and checkout building, and extend launch vehicle assembly building.

• **Pacific Missile Range:** $998,000 for telemetry, engineering, storage.

• **Various locations:** $5 million to begin work on the National Nuclear Rocket Test Facility; $16.8 million to improve Minitrack and deep space nets with new radar for the active communications satellite; $1.2 million for F-1 and 200,000-lb. liquid hydrogen test facilities; and $500,000 for sounding rocket facilities. Also included is $750,000 for contingency in unforeseen construction requirements and damage repair.

Employment level at NASA headquarters is estimated to be 919, up 135. Western Operations Office work force is to increase by six employes to a total of 65, the AEC-NASA office is to increase by one employe to a total of five, and Life Sciences Station is to gain 30 employes for a total force of 51.

Eisenhower Warns Nation Against Threat of Military-Industry Power

Washington—President Eisenhower took particular pains to warn against the potential dangers of concentrating too much power in the U. S. defense industry-military complex in his farewell address to the nation last week.

Noting that the constant threat of aggression forces the nation to maintain a powerful military force in being, the retiring President warned that statesmen must guard against "the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex."

Observing that the technological revolution of recent decades has brought more government participation and group effort to the formerly individualized research effort, he cautioned against the dangers of permitting the government to dominate and intimidate this effort. But he also cautioned against the opposite hazard that public policy might "become the captive of a scientific-technological elite."

President Eisenhower told the nation that "it is the task of statesmanship to mold, to balance and to integrate these and other forces, new and old, within the principles of our democratic system . . ."

He also warned against "spectacular and costly action" to meet recurring crises. He said that periodic impulses to increase "newer elements of our defense" and dramatically expand basic and applied research must be weighed in light of the "need to maintian balance in and among national programs."

Discussing the military power the nation now must maintain to meet its commitments, he observed that the U. S. no longer can depend on improvising in an emergency and has been "compelled to create a permanent armaments industry of vast proportions. Added to this, three and a half million men and women are directly engaged in the defense establishment. We annually spend on military security more than the net income of all U. S. corporations."

President Eisenhower said that "this conjunction of immense military establishment and a large arms industry is new in the American experience," and its total influence is widely felt throughout the nation. Recognizing the need for this development, he warned that "we must not fail to comprehend its grave implications."

"In the councils of government," he said, "we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist.

"We must never let the weight of this combination endanger our liberties or democratic processes," he said. "We should take nothing for granted. Only an alert and knowledgeable citizenry can compel the proper meshing of the huge industrial and military machinery of defense with our peaceful methods and goals, so that security and liberty may prosper together."

Along with the unaccustomed military situation, President Eisenhower commented on the trend toward more centralized, formal, complex and costly research, with the federal government carrying a steadily increasing share. He observed that scientific task forces have overshadowed individual research, and that there has been a revolution in the conduct of university research.

"Partly because of the huge cost involved, a government contract becomes virtually a substitute for intellectual curiosity. For every old blackboard there are now hundreds of new electronic computers," he said, warning that the prospect of "domination of the nation's scholars by federal employment, project allocations and the power of money is ever present—and is gravely to be regarded.

"Yet in holding scientific research and discovery in respect, as we should, we must also be alert to the equal and opposite danger that public policy could itself become the captive of a scientific-technological elite," he said.

Germans May Operate Airbase on Corsica

Bonn—West German and French governments hope to reach final agreement within the next two months leading to the establishment of a West German air force training unit on the island of Corsica.

The airbase located at Solenzara and still under construction would be used by air force operational training units for air-to-air gunnery and bombing exercises which are difficult to carry out within the confines of the heavily-populated German interior. The base, which will come under the official jurisdiction of the North Atlantic Treaty Organization, is to be completed by next fall.

German air force, under agreement with Italy, has maintained an F-84 fighter-bomber training wing in Sardinia to the south of Corsica for the past year. Canadian and Italian air force units also are based in Sardinia.

ARDC Preparing Report Stressing Need for Military Space Program

Dallas, Tex.—Air Research and Development Command has set up a committee of about 15 prominent scientists and industrialists to take a fresh, completely uninhibited view of U. S. Air Force space programs that will be required to provide this country with an adequate defense, ARDC Commander Lt. Gen. Bernard A. Schriever revealed here last week.

Indications are that the report, which Gen. Schriever expects to have in his hands in mid-February, will provide the Air Force with a major tool in promoting a much stronger and wider-based military space program than it has had available in the past. Even more important, it indicates that the Air Force will seek a much larger role in the national space program than it has been permitted in the past because of previous emphasis by top U. S. leadership on space efforts directed toward scientific and peaceful pursuits.

The report is also to be made available to the National Space Council, Gen. Schriever noted, and he expects that under the strong leadership of Vice President Lyndon Johnson, there should be "favorable changes" in the Air Force position as well as the civilian programs.

Gen. Schriever, speaking at the seventh annual meeting of the American Astronautical Society, stated that he was greatly concerned with the feeling among many Americans that the U. S. civilian space program represents our national space program and he emphasized that the civilian effort cannot be our total space program, because the military and civilian missions in space "do not merge into the single image."

"Our military requirements for space will not be completely satisfied with the developments under way or planned in our civilian programs," he stated, and also noted that "the importance of satellites and other space systems as essential elements of our military strength is not fully appreciated."

The answer to the change in the U. S. strategic position—and our relations with the world—brought about by atomic energy and rocket missiles in the space age, lies in space, he stated.

In our concern for a space program we have, of necessity, been preoccupied with the prestige shots, but in our concern for peace we may not have fully exploited all avenues leading toward the preservation of peace, he said.

Schriever indicated that perhaps a misunderstanding of the importance of USAF programs, aimed at improving reconnaissance, detection and communications, has been largely due to lack of publicized Soviet interest in these fields, "which has tended to play down their urgency in many Americans'" minds. He stated that the Soviets apparently have considerably less need for such systems than does the U. S. Being the aggressor nation and with superior target information, it enjoys a tremendous lead in the nuclear rocket world of today.

In the field of military intelligence, the USSR has no problem, Schriever stated. It can easily assess the strengths, weaknesses and intentions of the U. S. and the free world. To restore the imbalance in intelligence, space systems possess the greatest potential to accomplish U. S. intelligence objectives—and Gen. Schriever warned—"A surprise nuclear attack on the U. S. would be millions of Pearl Harbors rolled up into one."

Schriever also answered "definitely no" to a query as to whether he thought that the military space mission would be enhanced by setting up a completely new, independent U. S. space service, noting that "we have enough trouble with three services without adding a fourth." He stated that no one service should carry the predominant military space mission role, but emphasized that in his opinion, the U. S. Air Force should be the predominant service in space.

A forum, held in conjuncition with the AAS meeting here, had as panelists, Gen. Schriever; Werner von Braun, director of NASA's Marshall Space Flight Center; Olin Teague, House Committee on Science and Astronautics; and Fred L. Whipple, director of the Smithsonian Astrophysical Observatory.

Most agreed that lack of money, rather than talent, was the severest handicap suffered by industry and government agencies in developing present capabilities into more effective space programs. Von Braun and Gen. Schriever believed that greater flexibility in budget spending would provide increased benefits. However, Congressman Teague indicated that he did not favor relaxing such controls.

Gen. Schriever, in discussing man-in-space, stated that he foresaw the first necessary role as that of a "repairman." One of the big problems in space opera-

Moon Ionosphere Has Radio Wave Effect

Dallas, Tex.—Existence of a "peculiar type of ionosphere" above the moon's surface that has effects on propagation of radio waves similar to that of the ionosphere of earth and Venus, and therefore may play a role in communications with the moon, was described here last week by Dr. S. F. Singer, of the University of Maryland.

In the usual planetary ionosphere, the upper atmosphere is partially ionized and the density of the electrons is less than the density of atoms, Dr. Singer noted. "For example, for the earth, near 300 km. [190 mi], the electron density is 1 million per cubic centimeter, the atom density is 10,000 times greater. But for a nearly airless body in space, such as the moon, a body too small to retain an atmosphere, the situation is different," he explained.

"We estimate the density of atmosphere as less than 100 hydrogen atoms per cubic centimeter, but the density of electrons as 10,000 per cubic centimeter near the lunar surface," he added. The mechanism which creates this electron layer, or cloud, is based on the sun, Dr. Singer noted.

Solar ultraviolet photons constantly bombard the lunar surface and liberate photoelectrons and those of the very highest energies will escape into interplanetary space and leave behind a positively charged moon, with an approximate potential of 30-40 v., he reported.

But the bulk of the photoelectrons do not have enough energy to escape. They are emitted from one square centimeter of lunar surface at the rate of several billion per second. They spend a little time above the lunar surface before returning under the influence of a strong electric space charge field, according to Dr. Singer.

According to Dr. Singer, the strength of this space charge field has been estimated and it has been found large enough to cause other important effects on the moon. The field emits small, positively charged dust particles from the lunar surface. Because of their positive charge they reduce and partly cancel the negative space charge of the electron cloud and allow it to expand to a greater distance, of the order of several feet. The electron field also is reduced, the dust particles fall back to the surface, but others rise to take their place. This action provides on the moon a "dust ionosphere" made up of positively charged dust particles and negative electrons, Dr. Singer said.

tions is mean time to failure of components and with the advent of capability of sending big payloads into space, there would be a priority requirement for maintenance personnel to protect the millions of dollars of investment that these larger vehicles will represent. Next requirement would be men in space to operate military equipment, then human observation, and perhaps lastly, using men to control vehicles through the atmosphere and return them to designated points on earth. There is no question, he noted, that we will use the space medium for transportation between points on earth because of the tremendous speed breakthrough that this method will achieve.

Von Braun and Whipple emphasized the need for spending more funds on research to build firm foundations of knowldege to make future space programs work. Current research funding is out of balance, von Braun indicated, citing as a case the large sums being expended on programs to go to the moon, while minor expenditures are made available to astronomical laboratories which could provide invaluable information regarding the environment and problems likely to be encountered upon arrival on the moon or other planets. What is needed here, he felt, was providing someone or some group with the responsibility and money for pursuing ground-based science concurrently with space programs.

A critique of U.S. man-in-space programs—such as Project Mercury—was given by Lloyd V. Berkner, president of Associated Universities, Inc., who stated that we must "reappraise" man-in-space so that we do not waste money and mortgage future programs which would be more lucrative on purely scientific grounds. He indicated that he felt our man-in-space effort was marginal because of "our backwardness in the weight-lifting competition"—although the USSR seems to be behind the U.S. in capsule design. He felt that at the present time there is a "preoccupation" with man-in-space programs to the detriment of our capability for capturing vital information in large quantities using automatic instrumentation, a field in which we are ahead of the Soviets.

Air Force Space Study Committee

Dallas—Air Force Space Study Committee (see story) is a blend of aerospace industry veterans and scientific talent drawn from the fields of nuclear physics and mathematics. Study committee members are:

- **Trevor Gardner, chairman. Gardner was a member of the Wiesner task force that reported recently to President Kennedy on space and missile programs (AW Jan. 16, p. 26). He also is a trustee of Aerospace Corp. and president and board chairman of Hycon Manufacturing Co.**
- **Dr. Charles C. Lauritsen, trustee of Aerospace Corp. and professor of physics at California Institute of Technology.**
- **Dr. Jerome B. Wiesner, Kennedy's White House science adviser and one of the original trustees of Aerospace Corp.**
- **William C. Foster, vice president of Olin-Mathieson Chemical Co. Foster headed the Gaither Committee.**
- **Dr. Edwin Land, president of Polaroid Corp., who served with Wiesner and Gardner on the Kennedy space task group.**
- **Dr. W. Randolph Lovelace II, head of the Lovelace Clinic and chairman of NASA's Special Committee on Life Sciences.**
- **Dr. Arthur Kantrowitz, director of Avco Corp.'s Everett Research Laboratory.**
- **Dr. W. O. Baker, vice president-research, Bell Telephone Laboratories.**
- **Dr. Frank T. McClure, chairman of the Research Center of Johns Hopkins University's Applied Physics Laboratory.**
- **Dr. Harold Brown, director of the Lawrence Radiation Laboratory, operated by University of California for the Atomic Energy Commission.**
- **Dr. Stanislaw M. Ulam of the Los Alamos Scientific Laboratory, also operated for AEC by the University of California. Work done by Ulam, an internationally known mathematician, played a key part in development of the hydrogen bomb. Ulam also proposed two methods for using small nuclear explosions to propel space ships. One is being explored by General Atomics Division of General Dynamics Corp. under Project Orion (AW Feb. 29, p. 26). This work, now funded by Air Research and Development Command, has received a total of approximately $2 million to date. Wiesner's report to Kennedy urged encouragement of "entirely new ideas which might lead to real breakthroughs," and cited Orion as an example.**

The Air Force Space Study Committee was established in October. In November, it was augmented by a group headed by Dr. Theodore Taylor, who is a vice president of General Atomics and is technical director of Project Orion.

- **Dr. Conrad Longmier, a theoretical physicist from Los Alamos.**
- **Dr. Charles Townes, inventor of the Maser and a vice president and director of research for the Institute for Defense Analyses.**
- **Dr. John W. Tuckay, professor of mathematics at Princeton University.**
- **Dr. Mark Kac, of Cornell University's mathematics department.**

Space Conflict Blamed On Lack of Direction

Washington—Lack of clearly defined national space booster objectives has resulted in attempts to degrade the position of the National Aeronautics and Space Administration by "certain pressure groups within the Air Force and segments of industry," according to a House space committee report.

The report says the situation is not an indictment of the Air Force but stems from absence of strong top level direction, which creates inevitable conflicts of interest. The committee intends to investigate the over-all booster program in hearings to be held within a month (AW Nov. 21, p. 33).

Because of what the committee report terms an unhealthy competitive atmosphere, it said Congress should consider placing responsibility for booster development under a single agency. As space programs grow, the committee said, so will the possibility increase that NASA and Defense Department booster development efforts will begin to duplicate each other.

Large boosters should be developed to meet both military and civilian requirements because of high costs, according to the report. The committee says the operational Saturn cost per launch will be $17.3 million, and Centaur will be $9.1 million.

The committee report includes an analysis of existing booster technology in liquid, solid, hybrid, nuclear and electrical systems. Conclusions are:

- **Liquids** require advances for large boosters in reliability of pumps, valves, pressure regulators. Possibility exists for increasing specific impulse to 500 sec., but fluorine and tri-propellants may prove costly and hazardous.
- **Solids** are very promising in ruggedness, reliability, storability, simplicity and economy, but effort is required to determine their full potential.
- **Hybrids**, using solid fuel and liquid oxidizer, show promise by overcoming limitations of both all-liquid and all-solid boosters. Critical problem is uniform injection of the oxidizer down the core of very large motors.
- **Nuclear** systems show great promise, but difficulty in test and development places the timing for such a system in 1970. Committee cautions that chemical developments should not be abandoned in favor of nuclear rockets.
- **Electrical** systems should be nurtured in research, but due to heavy weights required, early application depends on major technological advances.

Great Britain, France Promoting Common European Space Program

Paris—France and Great Britain, in an effort to spur the beginnings of a common European space program, are jointly inviting 11 other European nations to attend a governmental conference in Strasbourg beginning Jan. 30.

A major goal of the two host nations at the conference will be to sell representatives of the other countries on a common booster system employing the British Blue Streak IRBM as the first stage and the French Veronique research rocket as the second stage (AW Dec. 26, p. 25).

British Minister of Aviation Peter Thorneycroft was scheduled to visit Italy last week and Switzerland this week to discuss the Strasbourg meeting and boost the cause of the Blue Streak-Veronique combination. He had paid earlier visits to West Germany and Scandinavia. However, in West Germany at least, it is believed that he met with little success (AW Jan. 16, p. 36).

A joint statement issued by the British and French governments said commonwealth nations also are being invited to attend the conference. Their roles and names were not specified.

Invited European nations include those which attended an organizational meeting in Geneva late last year to pave the way for an European Space Research Center (AW Dec. 12, p. 29) plus two others—Italy and Austria. Those attending the Geneva session and invited to Strasbourg are Belgium, Denmark, France, West Germany, The Netherlands, Norway, Spain, Switzerland and Sweden plus Great Britain and France.

Italy took the first successful step in its space program with the launching of a two-stage Nike-Cajun containing a sodium flare experiment to measure wind shear and activity up to an altitude of 106 mi. Booster and technical assistance were supplied by the U.S., and the payload was designed largely by Italy's National Research Council. The Council and the Air Ministry each have set aside $485,000 to continue upper air research, eventually with all-solid rockets developed in Italy. Launch was from Perdasdefogu, on the east coast of Sardinia.

The Strasbourg conference apparently has no direct connection with the earlier Geneva meeting, although officials stressed that it would not work at cross purposes with the earlier session in Switzerland and its proposals.

At that time, it was announced that a commission charged with drafting ways and means of making the Space Research Center a reality would meet in Paris after at least six governments representing 70% of the group's $200,000 organizational budget had given formal approval to the project. It is believed that this goal has not yet been reached.

Since two of the nations—Sweden and Switzerland—are neutral nations, participants at the Geneva meeting and the French and British invitations stressed that the purposes were strictly non-military. Objectives include communications and weather observation probes and satellites.

In another move in which it was again explained that it posed no threat to the Geneva objectives, France has agreed to a cooperative space venture with the U.S. similar to those already arrived at with Britain and Canada. Plans call for a Chance Vought Scout developed for the National Aeronautics and Space Administration to boost a French payload into orbit in late 1962.

Formal agreement with NASA is expected in March during the visit of a French delegation to Washington headed by Pierre Pigagniol, delegate general to the National Committee for Scientific Research, and Pierre Auger, president of the French Committee for Space Research and a leading figure at the Geneva conference.

France also is working on a national space program; it is understood that the primary purpose for a joint effort with the U.S. is to give the European nation a place in space at a time before its own booster vehicle, or the Blue Streak, is fully developed.

Agreements already have been signed by the U. S. and Britain for Scout-launched electron measurements satellites, and by U. S. and Canada for ionospheric topside sounders. Initial Canadian experiments will be launched by Scout, and later satellites by Thor Agena B.

Tory II-A Accident

Washington—High power demonstration run of Atomic Energy Commission's Project Pluto Tory II-A test vehicle, scheduled Jan. 28 at the Nevada test site, has been canceled and will not be rescheduled until Tory II-A accident damage has been assessed.

The system was damaged when the railway car carrying the test vehicle was unhitched from its locomotive and rolled downhill into a concrete bunker. The reactor core was not in the test vehicle when the accident occurred.

The locomotive-railway car arrangement for handling Tory II-A has a triple safety system. The locomotive is hitched to the car with a remotely-controlled coupling, there is a safety cable and the car has a spring-loaded, fail-safe braking mechanism.

At the time of the accident, the brake system was not installed because it was being overhauled, the safety cable was not connected and the remotely-controlled coupling was opened, permitting the railway car to roll freely downhill into the bunker.

It probably will take a month to put Tory II-A back into operating condition and another two weeks to evaluate damage to its control equipment, which can be adequately determined only when Tory II-A is in operational status.

Rover Bidder Briefing Delayed for Decision

Washington—Industry briefing on the Project Rover nuclear propulsion rocket, scheduled for last week, has been postponed pending determination of how responsibility will be distributed among the Atomic Energy Commission, National Aeronautics and Space Administration and the prime contractor.

A team of advisers has been formed to define the general concept of nuclear space propulsion, and to determine the most feasible list of bidders. Called the Nuclear Propulsion Study Committee, the team is composed of representatives of Thiokol Chemical Corp., United Technology Corp., Grand Central Rocket Corp., Aerojet-General Corp., Rocketdyne Division of North American Aviation and the Martin Co.

No new date has been set for the industry briefing, but bidders will have 60 days after the briefing in which to submit proposals for the Rover engine. In addition to basic propulsion capability, bidders will have to justify capabilities in electrical power and hydrogen handling fields.

ITT to Moon-Bounce Signals to England

Washington — International Telephone & Telegraph Corp. will begin moon-bounce communications experiments soon between Nutley, N. J., and England, following receipt of Federal Communications Commission authorization and temporary assignment of frequencies in the 2,000-mc. band.

ITT expects to transmit both teletype and voice by moon bounce. Tests will be expanded later to include narrow-bandwidth transatlantic television using new 140 ft. diameter Rebound passive satellite which National Aeronautics and Space Administration expects to launch this year.

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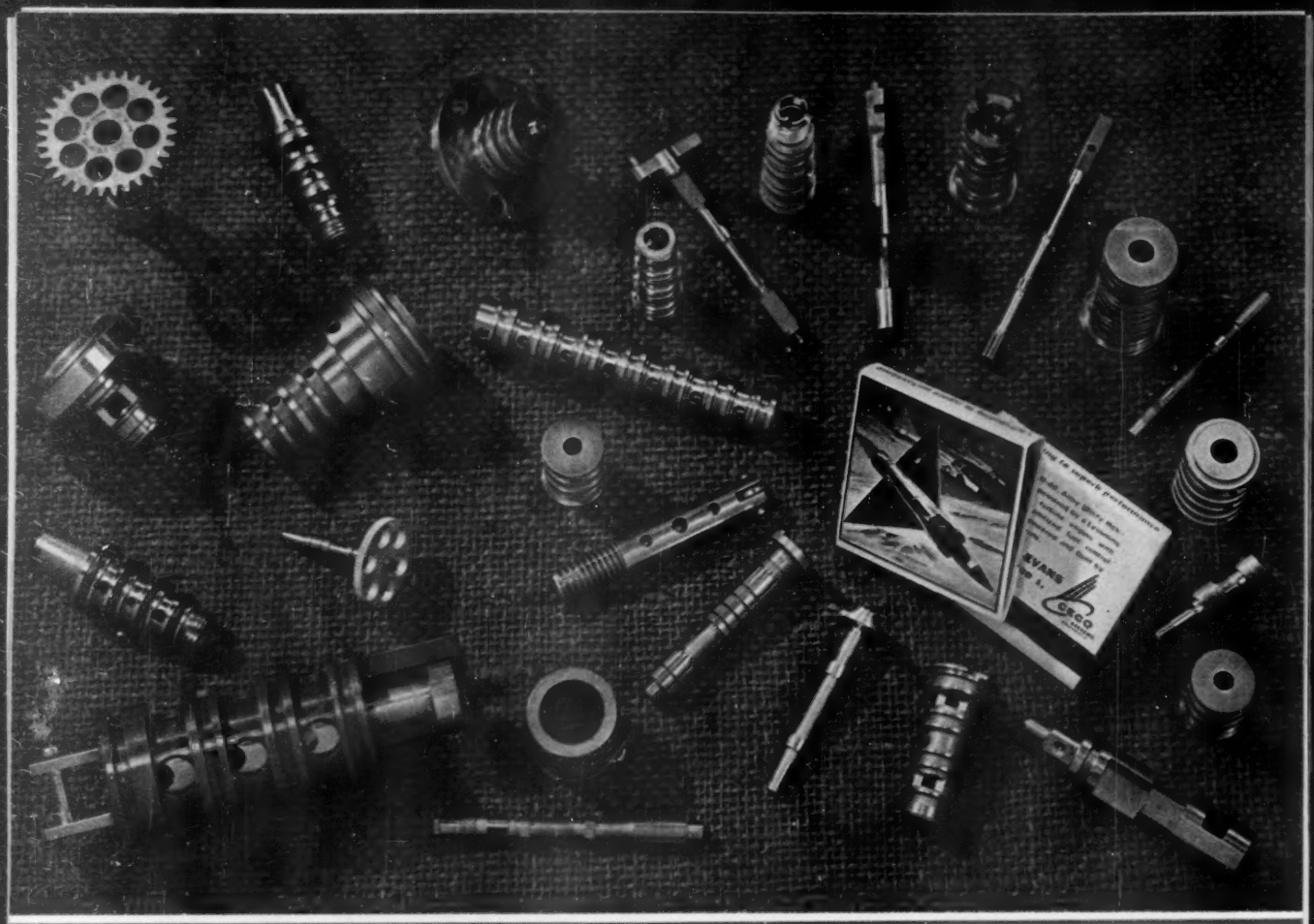

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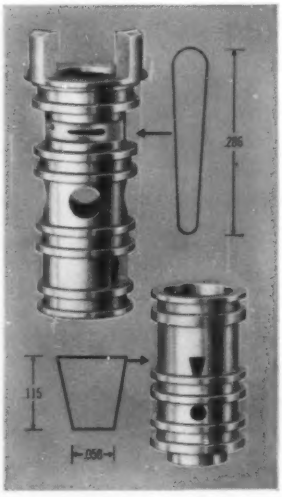

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Long Terms Urged for Defense Officials

By Katherine Johnsen

Washington—Defense Department's new top officers promised to serve indefinitely—until asked to leave by the President—as the Senate moved quickly last week to confirm them.

Perturbed at the frequent changes in top Pentagon posts, members of the Senate Armed Services Committee at confirmation hearings specifically obtained this commitment from each of Kennedy's appointees: Robert McNamara, secretary of defense; Roswell Gilpatric, deputy secretary; Dr. Elvis Stahr, Army secretary; John Connally, Navy secretary; and Eugene Zuckert, Air Force secretary.

The terms of secretaries of defense have averaged less than two years since the post was established in 1947. Service of deputy secretaries has averaged less than a year and a half.

The Senate set the background for long-term Pentagon service last year by voting a resolution providing that appointees "shall indicate their willingness to serve so long as the President desires" because "the complexities and technicalities of national security problems have steadily increased the minimum period of government experience required before responsibilities can be discharged effectively. . . ."

The nominees were quickly and unanimously approved, following smooth and pleasant hearings, with much time spent on high praise of each of the nominees by Republican as well as Democratic senators. This was in contrast to the argumentative sessions on the 1953 confirmation of Charles Wilson as secretary of defense, which developed from Wilson's reluctance to sell his stock to conform with conflict-of-interest regulations and established an antagonism between Wilson and Armed Services Committee members. In the case of Sen. Richard Russell (D.-Ga.), subsequently chairman, the antagonism was bitter and open and lasted throughout Wilson's tenure.

The committee also approved nominees last week for five of the eight assistant secretary of defense posts: Charles Hitch, comptroller; Cyrus Vance, general counsel; Paul Nitze, international security affairs; Arthur Sylvester, public affairs; and Thomas Morris, supply and logistics.

Conflict-of-interest was only a technical legal problem. All of the appointees with interests involving possible conflict readily agreed to abide by the decision of the committee's legal counsel.

Only McNamara had had a substantial holding in a major defense contractor. He proposed putting $1.1 million, after taxes, from the sale of Ford Motor Co. stock in a trust, accepted the committee's conditions as to the detailed arrangements of the trust, and volunteered to periodically make public the investments of the trust and his own income tax returns.

Under questioning, McNamara told the committee:

• **He and Deputy Secretary Gilpatric** will participate in sessions of the Joint Chiefs of Staff, a practice started by outgoing Secretary of Defense Thomas S. Gates.

• **There will be no** executive control to discourage military officers from testifying frankly to congressional committees.

• **The press policy** will be "open door," but whether this can be best implemented by regular press conferences has not been decided. Sen. Russell urged that the individual service information offices be centralized under the assistant secretary of defense for public affairs. McNamara favors this, Sylvester said.

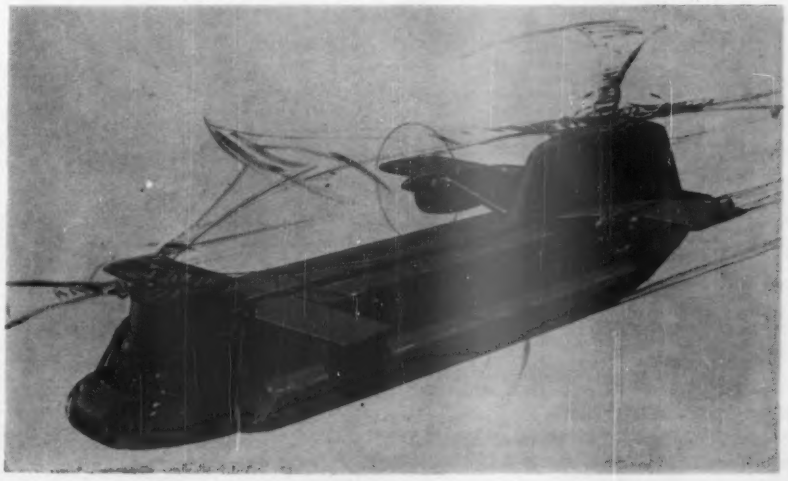
• **No major organizational** changes will be made until there is "a study in full." Questioned on the Symington reorganization plan aimed at further defense unification (AW Dec. 12, p. 34), Stahr said he had not read it, while Connally and Zuckert said they had not studied it sufficiently to draw conclusions. Gilpatric, a member of the Symington group that worked out the advisory report for Kennedy, said that although he agreed to its recommendations, he would accede to any decision made on reorganization by McNamara.

• **In conference** with Secretary of State Dean Rusk, McNamara said it had been agreed to extend to the maximum "intimate relationships at all levels" between the two departments.

• **Modernization** of the ground forces and providing airlift for mobility will be one of his first major projects, McNamara said.

Vertol Proposes Advanced Helicopters

Vertol 107-VI with two General Electric T58s (1,400 shp.) would be cleaned up to cruise at 176 kt. compared with 138 kt. for Model 107-II. Rotor blades would have increased chord. Gross weight would be 19,130 lb., payload 5,025 lb. or 25 passengers. Tandem stub wings on compound Vertol Chinook YHC-1B (below) would add weight but increase cruise from 160 kt. to 227 kt. Gross weight would be 33,800 lb., up from Chinook weight of 32,000 lb. Direct operating costs would drop from 5.5 cents per seat-mile to 4.9 cents.



Seaborg Is Named to Head AEC; Elvis Stahr to be Army Secretary

Washington—Najeeb E. Halaby was named administrator of the Federal Aviation Agency as John F. Kennedy continued to staff his new administration prior to his inauguration as President late last week.

Earlier, Dr. Glenn T. Seaborg was named Atomic Energy Commission chairman and Elvis J. Stahr was appointed Army Secretary, along with these other top officials in the new administration:

• **Joseph Charyk** was reappointed as under secretary of the Air Force. Before he became under secretary last year, Charyk served as USAF assistant secretary for research and development.

• **James H. Wakelin** was reappointed as assistant secretary of the Navy for research and development, a post he has held since 1959.

• **Thomas D. Morris,** assistant director for management and organization of the Budget Bureau, as assistant secretary of defense for supply and logistics.

• **Lyle S. Garlock** was reappointed assistant secretary of the Air Force for financial management, a post he has held since 1954. Before that he was deputy comptroller in Defense.

• **Norman S. Paul,** former deputy director of the Foreign Operations Administration, was named assistant to the secretary of defense for legislative affairs.

• **Nils A. Lennartson,** who served as public affairs assistant to Treasury Secretary Anderson in the previous administration, was appointed deputy to Assistant Secretary of Defense for Public Affairs Arthur Sylvester.

• **J. P. Ruina,** who has been assistant director for air defense in the Office of Defense Research and Engineering, was named director of the Advanced Research Projects Agency.

• **Herschel C. Loveless** was nominated for membership on the Defense Renegotiation Board. A former governor of Iowa, Loveless was an unsuccessful candidate for the Senate last year.

• **John F. Horne** is to be administrator of the Small Business Administration. He has been administrative assistant to Sen. John Sparkman (D.-Ala.), chairman of the Senate Select Committee on Small Business.

• **George Docking** was named a member of the Export-Import Bank board of directors. Docking was defeated last year in his bid for re-election as governor of Kansas.

• **John S. Gleason,** Chicago Helicopter Airways' president and treasurer, was appointed administrator of the Veterans Administration.

Halaby, 45, is a lawyer and currently is secretary and treasurer of Aerospace Corp. He received his private pilot's license in 1933 and became an Army Air Force instructor in 1940. He flew as a Lockheed test pilot in 1942-43 and a Navy test pilot in 1943-46. Halaby founded the Navy's test pilot school and was its first chief instructor. He flew the Bell P-59, the first U.S. turbine-powered aircraft, and in 1945 he was the first U. S. pilot to make a continuous transcontinental jet flight.

Joining the State Department in 1946 as an intelligence officer, Halaby later became foreign affairs adviser to Defense Secretary James Forrestal. He was first chairman of the NATO military production and supply board and helped plan the U. S. overseas air base program. He was assistant to the Economic Cooperation Administration chief 1950-52, then assistant secretary of defense for international security affairs 1952-54.

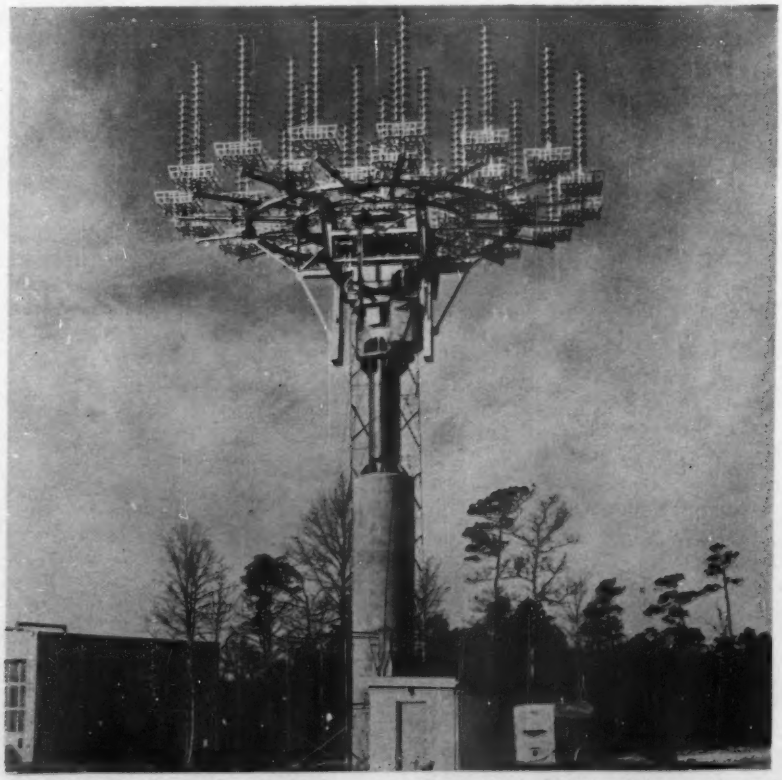
Halaby subsequently has been an associate of Laurance S. Rockefeller, vice chairman of the White House Facilities Study group, consultant to White House aviation adviser E. P. Curtis and a member of the Rockefeller Brothers Foundation study panel.

Dr. Seaborg, University of California chancellor, has long been active in the nuclear energy research field. He was a key figure in the discovery of fissionable isotopes which helped to make the atom bomb possible. It was work in this field which won him the Nobel Prize along with Dr. Edward M. McMillan, also from the University of California, in 1951.

From 1946 to 1950 he was a member of the AEC general advisory committee and from 1947 to 1951 a member of the National Research Council's committee on standards and units of radioactivity. He also was a member of Science Advisory Committee.

Dr. Seaborg is a member of the board of directors of the Nuclear Science and Engineering Corp. of Pittsburgh. Chairman of this board is Eugene Zuckert, new secretary of the Air Force and former member of the AEC.

Army Secretary Stahr, who has been president of the University of West Virginia since 1959, practiced law in New York eight years before moving into the field of education. During World War II, he was commissioned a second lieutenant in the Army, and when he was discharged in 1945, he was an infantry lieutenant colonel. During the Korean War he was special assistant to Secretary of the Army Frank Pace.



NEW 33-ELEMENT end-fire array antenna, recently installed at National Aeronautics and Space Administration's Wallops Station, will be used for telemetry. The 40-ft. antenna, which moves in azimuth and elevation, was produced by GB Electronics Corp.

Two B-58s Set 6 Speed Records; One Breaks 5 Soviet Speed Marks

By William S. Reed

Edwards AFB—Six world speed records were established by two Convair B-58 Hustlers here over a 1,000-km. (621.5 stat. mi.) closed course. Both aircraft, flown by Strategic Air Command crews from Carswell AFB, Tex., carried a 2,000-kg. (4,410 lb.) load. A top speed of 1,430 mph. was recorded by one of the Mach 2-plus bombers during the run.

The first B-58, flown by Maj. H. J. Deutschendorf, made two circuits around the 1,000-km. course extending from a point north of Edwards AFB to Gila Bend, Ariz., and shattered five Russian-held speed marks. Two days later a second Hustler, flown by Maj. H. E. Confer, topped Deutschendorf's record for the 1,000-km. course.

The records established by Maj. Confer in the second B-58 for the 1,000-km. course are:

- **Speed with no payload,** 1,284.73 mph. Former record was 700.47 mph., set by a USAF McDonnell F-101 in April, 1959. Average groundspeed was 1,330 mph.
- **Speed with 1,000-kg. payload,** 1,284.73 mph. Previous record of 639.18 set by Russia in October, 1959.
- **Speed with 2,000-kg. payload,** 1,284.73 mph. Previous 639.18 mph. record also was held by Russia having been set in October, 1959.

For the 2,000-km. closed course, the following records have been claimed:

- **Speed with no payload,** 1,061.808 mph. Previous record was 596.47 mph. set by a Russian Tu-104 last April. Average groundspeed was 1,130 mph.
- **Speed with 1,000-kg. payload,** 1,061.808 mph. Previous record of 596.47 mph. also set by Russia in Tu-104.
- **Speed with 2,000-kg. payload,** same as preceding.

The 2,000-km. record was established on Jan. 12 when two circuits were flown around the closed course. The run was commenced at 14,000 ft. and terminated near 50,000 ft. The crew gave no reason for starting the run at so low an altitude as 14,000 ft., but this probably was dictated by the necessity of conserving fuel for afterburner operation. Deutschendorf stated that only one wide circle was made after takeoff before entering the starting gate.

On the second lap, the average speed was 1,200.194 mph., but the over-all average for both laps was 1,061.808 mph.

The latter speed will be submitted for official recognition for the 2,000 km. closed course record.

Gross weight at takeoff was 148,000 lb., about 15,000 lb. below the B-58's design gross of 163,000 lb. Fuel reserve for landing was planned for 10,000 lb. Partial afterburning was used on the four General Electric J79-5 engines for the first lap with switchover to full afterburner during the remainder of the second lap. Maximum speed recorded by the navigator was 1,421 mph.

The 1,000-km. record set by Maj. Confer was flown on Jan. 14 and consisted of one lap over the same course. Full afterburning was used for the entire time and maximum speed attained was 1,430 mph. Unlike the first run, the course was entered at 44,000 ft., with the aircraft being cruise-climbed to 50,000 ft. at the end. Time from takeoff to landing was 29 min. 2 sec. General Electric reports that it would not be necessary for the crew to exceed either temperature or afterburner time limits on the 16,000-lb.-thrust J79s in order to achieve the speed necessary for setting the new records.

Both B-58s were in combat configuration rather than being specially rigged for the speed trials. Crews and aircraft are from Strategic Air Command's 43rd Bomb Wing at Carswell AFB, Tex. A weapons pod was carried by both craft throughout the runs.

ATT Satellite Planned

Washington—American Telephone & Telegraph Co. got Federal Communications Commission's authorization late last week to conduct a 1-year space communications experiment that will include launching of its own satellite. Voice and television signals will be relayed from Holmdel, N. J., to England, Germany and France. National Aeronautics and Space Administration will launch the satellite at cost. ATT's long-term plan is to provide a satellite network for worldwide space communications. The company will be the first commercial firm to have a satellite launched by the government.

News Digest

Vought Astronautics has been awarded a $105,000 contract and Douglas Aircraft a $92,000 contract to study feasibility of launch-from-orbit operations. The National Aeronautics and Space Administration studies (AW Nov. 7, p. 26) are due in six months. Packard Bell has a $3 million NASA contract to develop the Saturn automatic checkout system.

Nuclear-powered cruiser Long Beach will be armed with Polaris missiles in addition to the Talos and Terrier air defense and Asroc anti-submarine missiles originally planned.

United Systems Corp. has been formed to act as prime contractor and systems manager for Studebaker-Packard CTL Division; Amcel Propulsion, a subsidiary of Celanese Corp. of America; Merz-Chambers Corp. and Technology Instrument Corp.

Managements of Ling-Temco Electronics, Inc., and Chance Vought Corp. may be drawing the lines for a proxy battle. Ling-Temco has acquired a "substantial amount" of Vought stock, reportedly a holding of 15-30%.

Douglas Aircraft Co.'s board of directors reported a fourth quarter net profit of $2.4 million for Fiscal 1960 on total sales of over $1.7 billion. The fourth quarter profit reduced the company's net loss for 1960 to $19.4 million representing $5.89 per share. Last year's loss was $33.8 million or $8.86 per share. Douglas also will transfer its transport activities from the Santa Monica facility to its production facility at Long Beach by May 1, as part of the company's program to consolidate transport activities.

Max Lehrer resigned last week as assistant staff director for the Senate space committee to become director of defense business development for Radio Corp. of America, with headquarters in Washington.

Transpacific Denial

Washington—President Eisenhower disapproved a Civil Aeronautics Board decision in the Transpacific Route Service Case last week and directed the Board not to grant additional services on routes to the Far East because of possible unfavorable impact on foreign relations. Using high seat capacity of jet transports coupled with limited traffic potential on the routes as his reason for rejecting additional service across the Pacific, Eisenhower followed recommendations in a study submitted last month to the White House by United Research Corp. (AW Dec. 19, p. 40). He also recommended no additional service between the mainland and Hawaii until another Board review of Pacific area service two years from now indicates whether another airline is needed on the route.

Budget Urges Campaign to Reduce Subsidy

Effort proposed to cut cost of poor traffic stops; fare increases asked to offset higher fuel taxes.

By Robert H. Cook

Washington—Airline operating costs and route patterns could undergo extensive changes this year if Congress approves the policies laid down for the Civil Aeronautics Board and the Federal Aviation Agency in the Eisenhower Administration's Fiscal 1962 budget.

The budget proposed by the outgoing administration is tailored to the theme of balancing revenues against expenses. It calls for the airlines to pay a bigger share of federal airways system expenses and for local service airlines to help reduce the subsidy bill by eliminating unprofitable traffic stops. The budget is subject to change by President Kennedy, who was inaugurated late last week after it went to Congress.

The budget message to Congress proposes these legislative and administrative approaches to reducing government airways and subsidy costs:

• **Imposition of a 4.5 cent** fuel tax on the growing volume of presently tax-free jet fuel, plus a tax increase from 2 cents to 4.5 cents on aviation fuel. This is to help finance the federal airways. Commensurate fare increases were recommended to offset increased fuel costs.

• **Adherence to CAB's** use-it-or-lose-it policy for local airline service to reduce dependence on subsidy as one means of limiting federal aid to the airlines. Congress was urged to review the promotional policy in the Federal Aviation Act to determine whether there is any justification in paying subsidy for an airline stop that produces limited traffic. Congressional action would create tougher standards than the CAB policy.

• **New legislation declaring** that trunklines would operate subsidy-free for a specified period are permanently ineligible for subsidy.

• **Relaxation of depreciation** rules and allowances for industry generally, to offset deterrent effects of high taxes on investment. The budget proposed that any profits from the sale of depreciated property be treated as income for tax purposes.

Among other recommendations which could directly affect airline operations in the future, President Eisenhower urged Congress to establish a Department of Transportation to coordinate the "presently fragmented Federal functions" in this field. Also included in this budget message was a $1 million request for initial groundwork on a detailed census of business and industry, including transportation.

Noting that the government's expense in developing and modernizing air traffic control and navigation services has increased from $219 million in 1957 to an estimated $811 million through Fiscal 1962, President Eisenhower commended the progress made by the Federal Aviation Agency.

Although its continued modernization program will cause actual expenses to rise to an estimated $730 million in Fiscal 1962, he pointed out that a $40 million appropriation for a continuation of airport aid, which will require new authorizing legislation, is $24 million less than the sum appropriated for Fiscal 1961. This, the President said, "reflects the sound policy" that this item of federal expense should gradually be reduced to a point where the airlines and communities can eventually assume full responsibility for the construction of airports.

Severely critical of the mounting subsidy bill for local service, intra-Alaska and helicopter operations, Eisenhower estimated such payments average about $12 per passenger trip for all local service. Pointing out that CAB's subsidy bill of $82 million in Fiscal 1962 is expected to reach a peak the following year, but will remain above the $80 million level through 1966, he warned that strong demands for additional service and new routes could cause further increases in the subsidy expense.

Financial Needs

With the balance of its programed traffic control facilities scheduled for installation in Fiscal 1962 and the hiring of additional operational personnel nearly complete, FAA expects its financial needs to level off. Facilities to be provided under the total appropriation of $756 million in the 1962 budget should be adequate since the demands on the traffic system are not expected to increase at a greater rate. Growth rate should become more stabilized, FAA believes, because of an expected decrease in military air traffic and near completion of the airlines' jet programs.

FAA's new budget asks $686 million in new obligational authority, or $4.4 million less than the sum authorized for the current fiscal year. An additional request for $70 million, needed to pay airport aid contracts issued in 1961 and expected to be complete in 1962, brings the total appropriation to $756 million.

Largest FAA budget increase, $52.8 million to total operating expenses of $441 million, covers additional salary costs needed for 2,048 new positions, the full yearly cost of new services started on a part-year basis during Fiscal 1961, operational costs of new navigational

Federal Aviation Agency Budget

	FY 1961 Appropriation	FY 1962 Request
Operations	$388,164,000	$441,000,000
Facilities and equipment	164,600,000	126,000,000
Research and development	64,480,000	65,000,000
Operation and maintenance National capital airports	5,680,000	6,000,000
Construction, national capital airports	4,500,000	8,000,000
Grants-in-aid for airports	63,000,000	40,000,000
Total, new obligational authority	690,424,000	686,000,000
Grants-in-aid for airports (liquidation of contract authorization)	80,000,000	70,000,000
Total	$770,424,000	$756,000,000

aids which will be ready for service in Fiscal 1962, the cost of FAA's increased emphasis on establishing and enforcing civil air regulations, and increased cost of operating new aircraft purchased this year.

FAA says it has programed an annual $12 million saving in operational costs by rearranging personnel workloads to eliminate the need for 1,400 new positions. Total work force of the agency would be increased to 45,050 permanent positions under the new budget.

FAA's proposed budget plans a $38.6 million decrease in the facilities and equipment appropriation, which totals $164.6 million in the current fiscal year. Total funds of $126 million requested for this purpose include $109.2 million for purchasing and installing new navigation and traffic facilities, $10 million to buy nine aircraft needed for facility checking and flight training, and $6.8 million for research and evaluation equipment.

Total sum requested by FAA for the installation of new navigation and traffic facilities reflects the agency's near completion of this program and includes funds for two long range radars to be added to the 82 authorized through Fiscal 1961, a transition terminal center, 15 new radar beacon systems, an international flight service station, 50 Vortac installations, 21 VOR units, 16 ILS systems, 36 approach light systems, a subsonic fire test wind tunnel.

An appropriation of $65 million is being requested by the agency for research and development, compared with total obligations of $64.4 million for this purpose in the current fiscal year.

FAA points out that the research and development figure is misleading since more than $5 million of this spending, included here in 1961, has been transferred to the facilities and equipment budget estimates for Fiscal 1962.

Appropriations requested for actual research and development are up $10.3 million in the budget, with a $4.4-million gain programed for traffic control and navigational aid tests, a $3.7-million rise in funding for air safety research and a $1.9-million increase to cover the cost of aviation medicine research. The agency noted that it plans to increase its emphasis on the development of an automatic data processing and display system for air traffic control.

For the construction of future airports, FAA is asking for $540 million in new obligational authority, which will require new authorizing legislation. Requested as an extension of the federal aid to airports program under President Eisenhower's budget message, the additional sum would be granted to FAA for disbursement as an appropriation, as opposed to payments made under prior contract authorization.

Balance of the FAA budget is covered by $8 million needed for construction costs at Washington National Airport and Dulles International, which is expected to be ready for operation by mid-1962. An additional $6 million was requested for operational and maintenance cost at the two federal airports.

FAA is recommending the establishment of a federal corporation to operate the two airports as a means of applying any profits earned against the airports' operational costs, instead of returning such revenues to the Treasury Department. FAA also said it would recommend an increase in the aviation gas tax, plus a new tax on jet fuel, as a means of earning an estimated $122 million a year to offset its own operational expenses. Both measures were recommended in President Eisenhower's budget message.

Civil Aeronautics Board's request for a total appropriation of $93.1 million in Fiscal 1962 includes $84.2 million which it expects will be needed for subsidy payments to local service carriers, helicopter, and Alaskan operations. While the figure is $5.1 million less than the 1961 subsidy estimates, the Board noted that it does not reflect any actual reduction in subsidies because of a supplemental appropriation of $22 million that will be needed for back subsidy payments to the airlines.

Actual subsidy earnings of the 13 local service operators alone were estimated at $62.1 million for Fiscal 1961, compared with $68.1 million for the Fiscal 1962 budget estimate. Helicopter subsidy earnings are also expected to increase $1.7 million to a total of $6.9 million in Fiscal 1962, Board estimates indicate. The subsidy rise was attributed by the Board to the airlines' inauguration of new routes, purchase of new flight equipment and increasing operational costs.

Administrative expenses of the Board will require an estimated $8.9 million in the new budget, a gain of $1.1 million over the current fiscal year. Major share of this increased expense will be to finance salary costs arising from expanded work staffs planned by CAB in its safety and route case divisions.

The Board currently has about 779 employes and is authorized to expand this staff to 800 by the end of the current fiscal year. The 1962 budget would permit the hiring of 81 additional employes, 45 of whom would be assigned to the Bureau of Safety. Of the remaining positions, 13 are planned to aid CAB's economic staff in a move to expedite route case proceedings.

CAB's workload continues to rise, with the Fiscal 1962 budget estimating that 1,579 rate cases will be handled in that year, compared with the current estimate of 1,498 cases. Formal CAB hearings completed this fiscal year are expected to total 759 and will rise to 821 by the end of Fiscal 1962, according to Board budget estimates. A projection of accident investigations indicates CAB can expect to handle 799 investigations through the current budget year and a total of 851 in Fiscal 1962.

Seaboard Asks IATA Rate Cuts

Washington—Seaboard & Western Airlines will propose a new table of reduced transatlantic cargo rates to the International Air Transport Assn. Traffic Conference opening today in Paris.

The revised tariffs, which will be bitterly opposed by major flag carriers and could result in another deadlock of the reopened conference, have been tabbed by Seaboard as a "real must if a cargo breakthrough is to come this year." The traffic conference is meeting to consider cargo fares which were not settled at the conference in Cannes last fall (AW Oct. 17, p. 40).

Seaboard has keyed its rate tables to the fleet of five Canadair CL-44 turboprop freighters which the carrier is scheduled to introduce into regular service July 1. The tariff structure is based on a volume incentive pattern which provides for a decrease in rates as volume increases. For example, a shipment of 2,200-5,000 lb. from New York to London would cost 78 cents per pound, compared with the present rate of 83 cents.

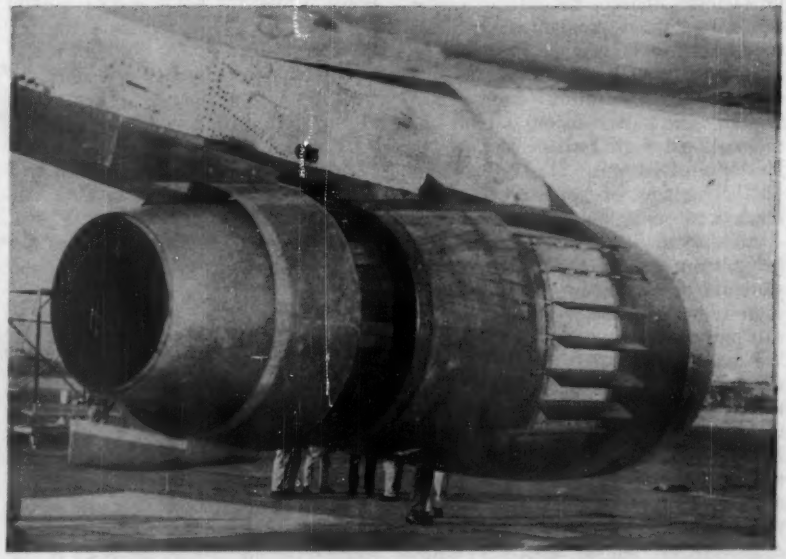
However, for whole shipments totaling 65,000 lb., the payload capacity of the CL-44 on the transatlantic route, cost will be only 28 cents per pound, contrasted with the 88 cents per pound in effect between New York and Paris.

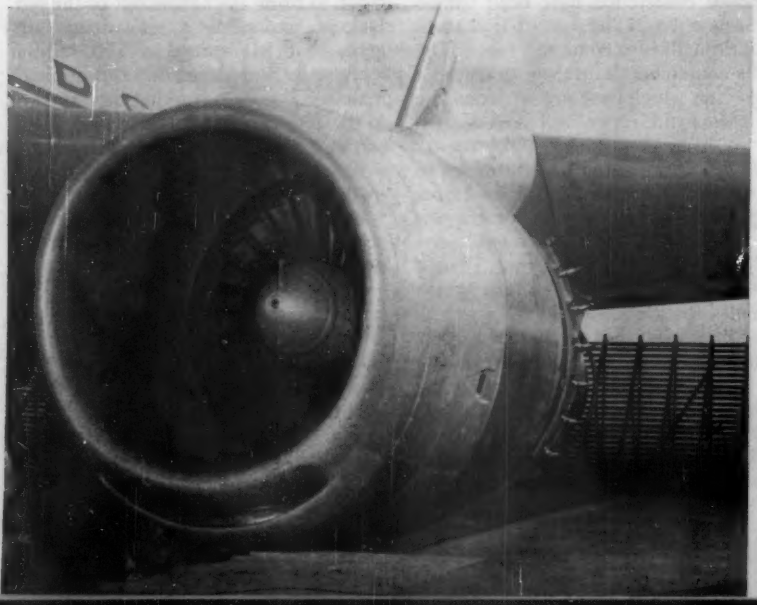
The proposed tariff is one of several projects introduced by the airline since Richard M. Jackson took over last year as board chairman and president in a move to bring the airline out of the red. Jackson undertook a refinancing program that has turned a $10 million working capital deficit into an approximately $2 million working capital gain. With few exceptions, he replaced the carrier's former board of directors with a new slate of eight members, and he made sweeping management changes as a first step toward bringing about new economies and stressing marketing techniques in sales.

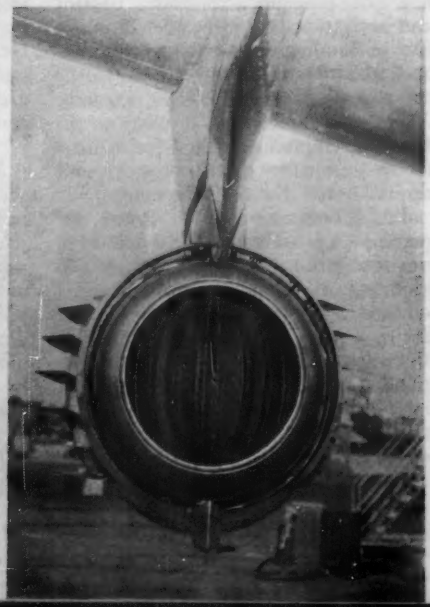
During the past three months, costs have been cut by $175,000 per month, and new methods for generating cargo traffic are being developed. These include a contract with Military Air Transport Service now in negotiation, which will provide Seaboard with a minimum guarantee of 600,000 lb. of cargo per month for one year.

Douglas Turbofan-Powered DC-8-50 Design Details

First Douglas DC-8-50, now undergoing flight tests at Long Beach, Calif., is shown with its 17,000-lb. thrust Pratt & Whitney JT-3D-1 turbofan engines. Engine pods, redesigned to accommodate the turbofans, are 230 in. long, 68.5 in. wide and 73.5 in. high. The air inlet is elliptical, measuring 45 and 46 in. on its major axes. Primary stream thrust reversal is afforded by tailpipe cascades (right) covered by a pneumatically actuated sliding conical band during forward thrust operation and by internal clam shell doors (lower right). Fan thrust is reversed by cascades aft of the fan discharge at either side of the engine. Fan reversers are covered by longitudinally mounted louver doors. For reverse thrust, the louver doors are opened (right) and the reverser cascades are swung into place in the fan discharge stream. The DC-8-50, with greater range and improved takeoff performance, has been ordered by United Air Lines, KLM, Iberia and Aeronaves de Mexico.







Prospects Dim for Transport Department

By L. L. Doty

Washington—Growing pressure for tighter control over federal regulatory agencies is now expected to bring about a revamped U. S. national transportation policy but chances, that a proposed Department of Transportation will be created at cabinet level under the Kennedy Administration appear slim right now.

The recent rash of critical studies of regulatory agencies (AW Jan. 9, p. 41) will evoke congressional hearings and investigations of the agencies during the next session of Congress, but it is now generally believed that any legislation calling for a drastic revision of transportation regulation will meet with strong congressional opposition.

May Spur Coordination

One major effect of the hearings, however, will be a demand for closer coordination between agencies regulating the various modes of transportation for the purpose of strengthening U. S. transportation facilities under a uniform operating policy.

President Eisenhower stirred new hope for proponents of a unified transportation approach last week in his final budget message to Congress. Commenting on "organizational reforms," Eisenhower, who traditionally has followed a conservative philosophy toward government reorganization, said that "a Department of Transportation should be established so as to bring together at cabinet level the presently fragmented federal functions regarding transportation activities."

Landis Influence

During the presidential campaign and throughout the post-election period, there was no evidence that the new President agrees or will agree with this stand. It now appears that President Kennedy will be guided by policies recommended by James M. Landis in a report that preceded his appointment as White House overseer of regulatory agencies (AW Jan. 2, p. 28).

Landis indicated in the report that he was opposed to the immediate organization of a Department of Transportation. He said that it would be feasible to develop an executive transportation department or "equally satisfactory goal" through an evolutionary process, but he was highly critical of plans and blueprints that have been proposed in the past for the organization of a Department of Transportation.

He termed them "unrealistic, beautiful in design but lacking in the appreciation of those earthy factors that are embedded in our regulatory transportation structure." The Landis position undoubtedly has Kennedy's support and it can be expected that the Landis-managed evolution of a new transportation policy will be backed by the new President. This process will be closely monitored by Congress.

Discussing inevitable congressional fears that the White House may be exercising too much control over regulatory agencies and the development of transportation policy, Landis had this to say in his report:

"The fact that the Executive Office of the President will play a large part in the architectonics of particular administrative programs should not be utilized as a basis for a claim of executive immunity from congressional scrutiny. . . . Weakness in planning or in the execution of plans are a matter of broad public concern and the Congress has its duty to discover and divulge these weaknesses, assess the blame for their occurrences, and assist in making such provisions as it can for their cure."

The fact that both Houses will provide stiff resistance against any moves to unduly strengthen White House control of regulatory agencies leads many observers to believe that the long-range objectives of the Landis proposals, which call for legislative changes, face severe opposition. Furthermore, Congress has consistently fought past moves to establish a Transportation Department and so far, such reports as the staff study for the Senate Commerce Committee (AW Jan. 9, p. 40) which recommended the creation of the department, do not appear to have noticeably changed congressional attitudes toward the proposal.

The railroad industry has not yet taken a formal stand on the latest proposals for a Transportation Department, although it is generally felt that the industry will support the move as a means of obtaining a more equitable balance in regulatory proceedings with other modes of transportation, and that their relatively stronger position within the over-all industry would give them a dominating role within an executive department.

Although truckers had not taken a firm stand on the issue either late last week, John V. Lawrence, managing director of the American Trucking Assn., said in a Chicago speech that if sweeping changes are necessary in government regulation, "then it must be concluded that for years the executive branch, the Congress, the regulatory agencies, the courts and all of us in the transportation business have been a bunch of meatheads."

ATA Position

Stuart G. Tipton, president of the Air Transport Assn., takes the following position:

"We do not propose to get ourselves mixed up in one giant, cumbersome and unwieldy transportation package. Whether that package be in the form of a jumble of transportation interests in one system, in the form of a single government regulatory body for all transportation, or both, aviation cannot take that backward step."

He said that Congress had "explored this question thoroughly" more than 20 years ago and rejected the idea by establishing independent agencies to "encourage, promote and develop" a strong air transport system. He cited a U. S. Supreme Court statement that "we see no reason why the efforts of the Congress to foster and regulate development of a revolutionary commerce that operates in three dimensions should be judicially circumscribed with analogies taken over from two-dimensional transit."

Policies Problem

One major problem that has developed under the present regulatory agency structure has been a failure to establish broad policies for individual modes of transportation or a general policy for all transportation. Attempts will be made to create such policies through closer coordination of agency activities.

Here again, however, airlines and motor lines will oppose any moves toward coordination which may represent a tangible step toward integration with railroads.

It thus appears that the Civil Aeronautics Board, among other federal agencies, will undergo some refurbishing during the next few years as a means of streamlining its activities, but that drastic changes in the relationship of industry to the agencies or to the federal government are not likely in the immediate future.

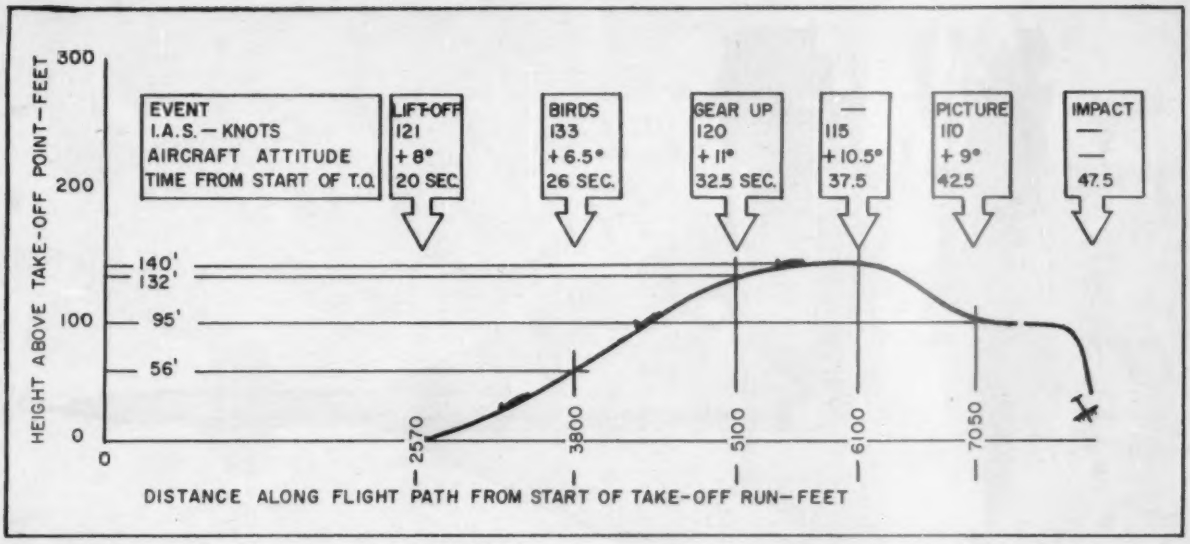
Il-18s Connect Moscow, Magadan

Moscow—Landing of an Ilyushin Il-18 at Magadan marked the inauguration of regular direct service on the 3,700-mi. route Moscow to Magadan, Tass reported. Magadan, on the shore of the Sea of Okhotsk in the northeastern Soviet Union, is connected by airlines with many remote points of the Soviet Arctic and the Chukotka Peninsula.

"Scratch the contact—it's a whale."

The U. S. Navy's job of protecting us from undersea attack is never easy, and the false alarms supplied by nature make it all the more difficult. Every clue must be investigated. What proves to be a whale today, may be an enemy submarine tomorrow. Vought Aeronautics is working with the Navy now in the development of technically advanced equipment designed to detect the enemy positively and leave him no escape. New aircraft for the most efficient use of new electronic search equipment, advanced sonobuoys . . . even space systems . . . are under development by Aeronautics and its sister divisions. They are part of a family of new antisubmarine warfare systems which would converge from the sea, air and space to pin down the enemy sub.

CHANCE VOUGHT AERONAUTICS DIVISION DALLAS, TEXAS



PROBABLE flight path of Electra was reconstructed by operations group of Civil Aeronautics Board investigators with aid of two photographs taken at Boston's Logan International Airport while plane was in the air. The profile assumes feathering of No. 1 engine after normal takeoff, subsequent loss of power on other engine or engines. At impact, three engines had almost full power.

Crash Spurs Further Bird Ingestion Study

By Glenn Garrison

Boston, Mass.—Crash last Oct. 4 of an Eastern Air Lines Lockheed Electra into Boston harbor will lead to a study of the flight safety effects of multiple bird strikes, according to a Federal Aviation Agency witness at a recent Civil Aeronautics Board hearing here (AW Jan. 16, p. 38).

Elmer J. Briggs, FAA powerplants engineer who was project engineer for certification of the Electra's Allison 501-D-13 turboprop engines, acknowledged at the public hearing into the crash that previous tests had not considered the operating effects of bird strikes into the engines. At that time, Briggs said, it had not been considered likely that more than one engine at a time would be affected by birds. Impact damage tests before the 1957 certification showed the engine has the structural strength to withstand direct impact, he said.

The new test program will get under way within a few months, Briggs said, and will attempt to find means of preventing ingestion and of minimizing the effects of ingestion.

Bird Control

Another FAA program connected with the bird hazard has been instituted since the accident, according to testimony of another of the agency's witnesses. James M. Leslie, Air Carrier Operations Specialist, said he had been assigned to a bird control project since mid-October. Previously, he testified, no FAA personnel had been responsible for coordinating the control of birds on airports, although assistance and advice had been provided by FAA.

Considerable testimony at the three-day hearing was devoted to bird strikes and their possible effect on engine performance. Bird carcasses on the runway following the accident and bird remains in three of the four engines provided circumstantial indications that a strike was related to the loss of one of the Electra's engines and possibly to the apparent power reduction on an additional engine or engines.

Visibility Loss

Another bird strike effect that received attention at the hearing was the possible loss of visibility by windshield smearing. The crew of an Eastern Electra flight that aborted on takeoff after a strike subsequent to the Oct. 4 accident testified that the windshield was completely covered by blood and feathers. It was pointed out that it was raining at the time of the takeoff abort and the windshield was partially cleared by the wipers. It was not raining at the time of the Oct. 4 crash and loss of visibility from bird smear was being examined as a possibility.

Other areas of scrutiny at the hearing included tests by Allison of bird strike effects on engine performance and tests by Lockheed of aircraft controllability under various power configurations, bank angles and speed regimes. These tests were conducted subsequent to the accident. Particular attention was directed to a condition of two engines out on the left side of the plane.

On the crashed airplane, No. 1 engine had been feathered and only No. 1 emergency handle pulled.

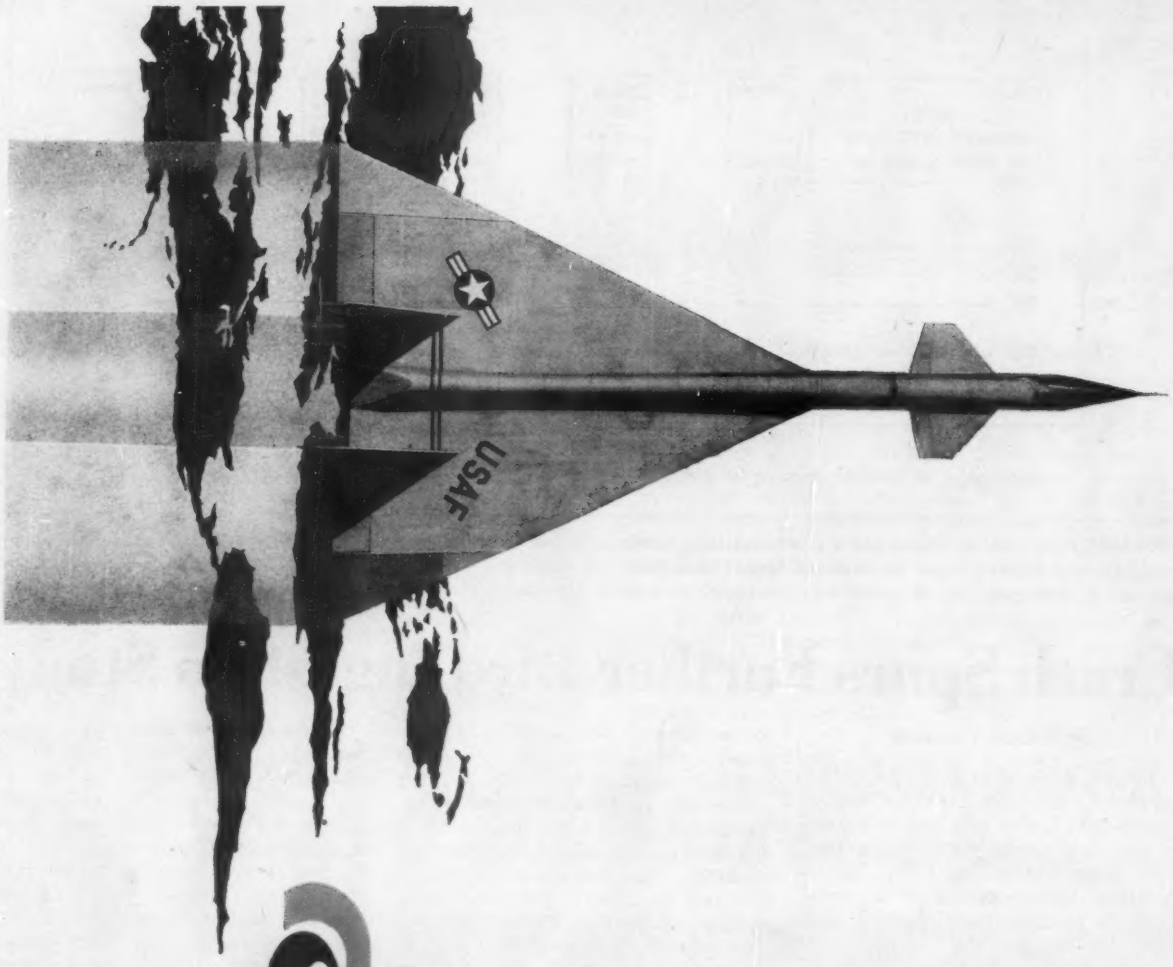
The actual amount of power available to the pilot of the ill-fated plane was a subject of some disagreement at the hearing. According to a reconstruction of the probable profile of the 47.5-sec. flight, a normal takeoff was followed by feathering of No. 1 engine, and then by additional power loss from engine failure, progressive power deterioration, or deliberate reduction on operating engines to maintain directional and lateral control.

Subsequent to the loss of No. 1, according to this reconstruction by the CAB Operations Group of investigators, power available totaled the equivalent of 3,500 hp., or the effective power of one engine at takeoff power. The total, however, could have been spread over many combinations of operating engines. Beyond the point at which the aircraft is thought to have stalled, almost full power had come back on three engines by the time of impact.

Allison Test Findings

However, R. W. Hicks, head of Allison's department of test projects and operations, took exception in his testimony to the 3,500 available horsepower figure. Allison bird ingestion tests, along with analyses of the amount of bird material found in the Electra's engines, indicated that considerably more power was available, Hicks said. Whether this power was used or not is another question.

The flight path was reconstructed by



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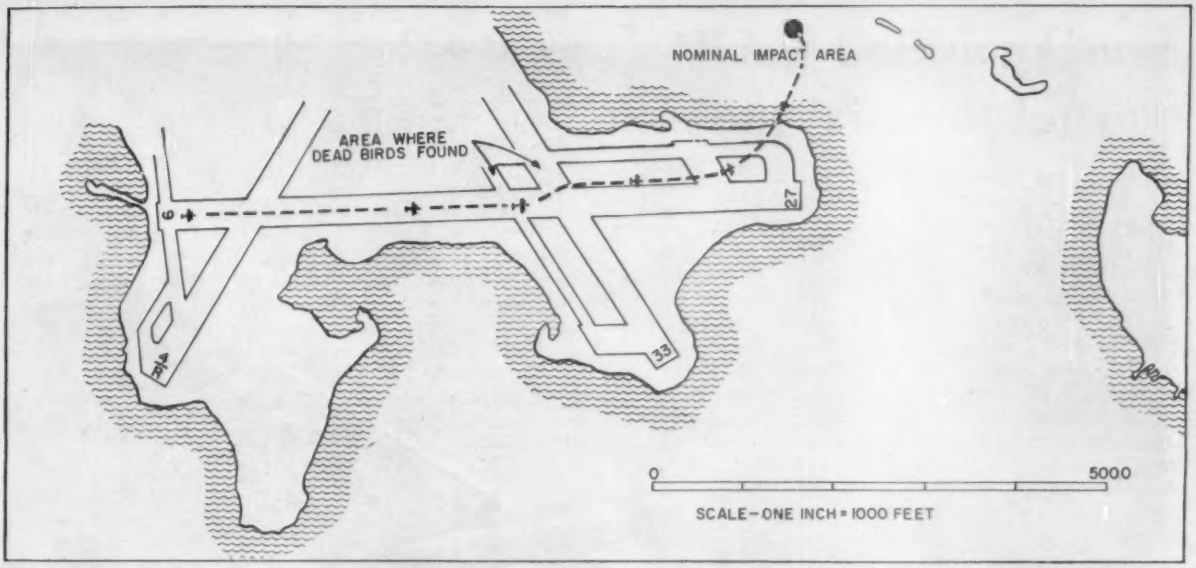


OPERATIONS group's reconstruction shows probable course of plane, including veer to left, temporary recovery of heading.

the Operations Group with the aid of two photographs taken near the intersection of Runway 9, which was the Electra's takeoff runway, and Runway 4R at Logan International Airport.

Photographic Evidence

These photos were made by Northeast Airlines Capt. Charles Jacobs and M. A. Williams, both amateur photographers, who happened to be taking pictures at the site. The investigators, using engineering data and assistance provided by Lockheed Aircraft, calculated the flight parameters after triangulating the positions of the aircraft. Maximum altitude during the flight was estimated to be 140 ft.

In the first photograph, the Electra was reported to have shown a 9 deg. nose-up attitude, altitude of 110 ft. above mean sea level, magnetic heading of 30 deg., nominal bank angle of 8 deg. left. The No. 1 propeller was feathered. In the second photograph, apparently taken a split second later, the aircraft had moved about 100 ft. along its flight path, nose-up attitude had increased by 5 deg., bank angle had increased 5 to 7 deg., and heading was about the same. Both photographs show a dark smudge-like formation above the runway which some speculation has ascribed to the presence of a flock of birds.

Engine Analysis

Analysis by the powerplants group indicated that there was no evidence of mechanical malfunction in any of the engines or their components. Engine No. 1 showed evidence of bird fragments in internal and external components. Evidence of bird matter was found in the bleed manifold air duct at the fifth stage, indicating, according to the report, that this might be a possible reason for propeller feathering. Negative horsepower of 875 shp. was indicated at impact.

On No. 2, internal and external components indicated bird fragments. There was 3,315 shp. at impact. Propeller blade angle at impact was about 39.9 deg.

Engine No. 3 was developing 3,310 shp. at impact. No bird fragments were found in internal engine components. Propeller blade angle at impact was about 40.9 deg.

Engine No. 4 showed evidence of bird fragments on internal and external components. At impact, there was 3,555 shp. Propeller blade angle was about 41.1 deg.

Subsequent to the accident, Allison performed a number of ingestion tests to determine the effect on performance of multiple bird strikes. Hicks testified that 2- to 4-oz. birds were used in the tests in quantities of one to eight birds. Ingestion of one bird, Hicks said, had practically no effect. Four birds caused a power loss for 2½ to 3½ sec.

Eight birds caused the loss for 4½ sec., or necessitated engine shutdown.

On five occasions where four birds were ingested, the test engine recovered only twice, Hicks said. But in any case where the engine recovery was not immediate, an overheat condition resulted that would have burned out the turbine blades had the engine not been shut down quickly, he said. Hot sections of the crashed Electra's engines showed no signs of overtemperature, he said, so it could be concluded that those engines met the conditions where recovery was made.

Service engines overhauled by Allison have not showed any signs of bird remains internally, Hicks testified. Of about 600 units overhauled last year, two showed evidence of bird fragments in the oil coolers from quick engine change sections, but never inside the engines.

Although this was not brought out in the testimony, Allison believes that only two or three birds went through any of the Eastern Electra's engines. This is based on the amount of bird material found in the engines, and would have resulted in a two- to three-second loss of power by Allison's calculations.

Allison Exhibits

Allison submitted exhibits based on its test program in which a probable loss and recovery of thrust pattern was plotted. One curve assumed that, at 26 sec. from start of takeoff roll, autofeathering is initiated on one engine and at the same instant two of the other engines ingest three small birds simultaneously.

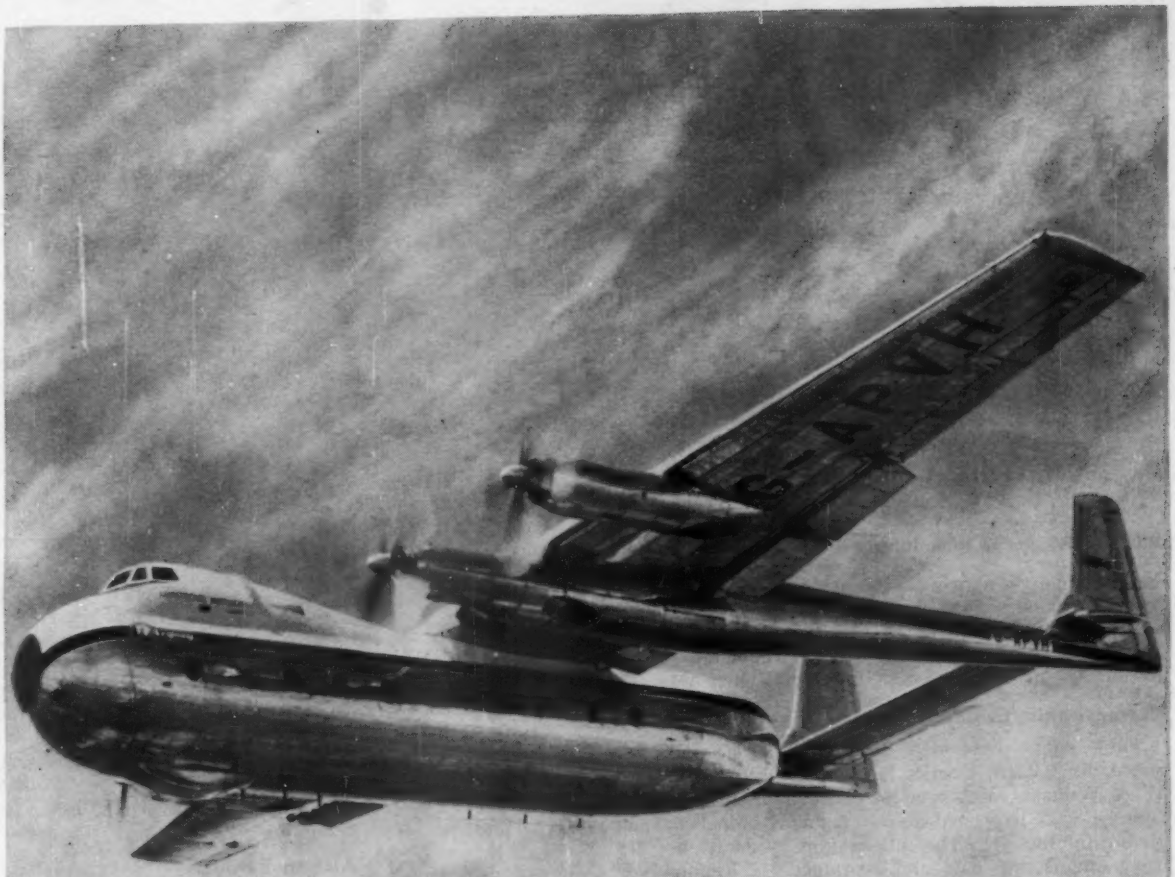
From a point of 35,000 lb. thrust, zero airspeed and zero seconds at takeoff, thrust has dropped to 27,000 lb. and airspeed has reached 133 kt. at the 26-sec. point. At 27 sec., thrust touches its lowest point, 13,000 lb. At the 30-sec. point, there is a surge to 19,500 lb. of thrust, and by 34 sec., thrust has leveled off at 18,800 lb.

A second curve assumes the autofeathering of an engine and three-bird strikes three seconds apart on two other engines. In this case, minimum thrust point is 16,600 lb., reached at the same 27-sec. mark, and recovery to 18,800 also is at the 34-sec. point.

Flight Tests

The Lockheed flight tests were described in testimony by C. R. Mercer, engineering flight test department manager of Lockheed and a member of the CAB operations group.

One of these tests involved maximum asymmetric power controllable at 115-120 kt. of airspeed with two



TODAY'S ECONOMICAL AIR FREIGHTER

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engines out and at various bank angles. The results of this test, Mercer reported, showed that if the two left engines of the Electra had failed, it would have been necessary to reduce power on the right engines to a combined total of a single engine at full power to retain control of the airplane. With the wings level and power equally distributed on the two right engines, less than 1,400 shp. could be used on each right engine. But if full power was applied to the inboard engine and zero power on the outboard, control of the aircraft could be maintained at and above 115 kt.

The Lockheed tests also explored in detail the effects of various boost-on and boost-off conditions. One purpose was to simulate complete electrical or hydraulic failure which would result in an inoperative control boost system, and to determine whether the Electra could be controlled in a boost-off condition with a failed engine prior to the boost system being shifted to manual. During these tests, directional control in terms of rudder force was the limiting factor. No particular difficulties other than fairly high forces existed in maintaining or changing bank angle.

Mercer testified, however, that he believed a rudder boost-off situation was not related to the accident.

Testimony at the hearing provided no evidence of systems failure.

The position of the boost control handle, however, came in for questioning during testimony by Capt. Frank Kearn, Eastern's director for flight crew training.

This control is placed near the captain's feet, and to use it, he must reach down and open its cover. Since the accident, Kearn testified, Eastern considered leaving these covers open during takeoff and landing, but decided against it.

Eastern has changed none of its cockpit emergency procedures since the accident, Kearn testified. He was questioned regarding engine-out training procedures both in the simulator and in flight.

An item in Eastern's flight manual that came in for questioning calls for emergency shutdown being done by the captain. This was compared with another item which allows the captain to delegate any emergency item to other crewmen at his discretion in an emergency. In view of the fact that immediate action items must be committed to memory by the crew, Kearn was asked if he felt cockpit confusion might not result from a deviation from normal procedure. Kearn replied that there should not be confusion if, when the captain found his attention needed for a different item, he called out to another crew member to take over an item he normally would handle.

Decision on Midair Collision Cause Hinges on Setting Time of Impact

By David H. Hoffman

New York—Probable cause of civil aviation's worst disaster, the Dec. 16 midair collision here, will remain unknown while investigators correlate three contradictory time sequences linked to events preceding the crash.

After questioning 77 witnesses during an eight-day public hearing here, representatives of the Civil Aeronautics Board, the Federal Aviation Agency, United Air Lines and the Air Line Pilots Assn. agreed that the record still did not resolve:

- **Why the pilot of** United's DC-8 Flight 826 overshot the Preston Intersection, his clearance limit, at a 438 kt. groundspeed.
- **Why radar controllers** in the New York Center failed to observe the jet's blip move beyond this fix and warn the pilot of his position.

According to Ronald DiGiovanni, a controller responsible for the DC-8 in the vicinity of Preston, Center's transmission "radar service terminated" was made at 10:33:01-20 EST. At the instant of this transmission, DiGiovanni insisted, the jet's blip was "one to three miles southwest of Preston" and still traveling toward the fix.

DiGiovanni's timing of his transmission assumed significance when Charles F. McErlean, vice president-law for United Air Lines, brought out that the jet's flight recorder had indicated the collision took place 11 mi. northeast of Preston at 10:33:32 EST. This timing of the accident was substantiated to a degree by CAB's interpretation of recorded pilot-controller conversation, which clocked the collision at 10:33:33-44 EST.

At the close of the hearing, it was apparent that further investigation would be required to pinpoint the DC-8's position during the crucial minutes just prior to the crash. But it was also clear that both DiGiovanni and the flight recorder could not be right. For if the jet was one to three miles southwest of Preston at 10:33:01-20, it would have had to make good a groundspeed of roughly 1,300 mph. to reach the collision site at the time indicated by the flight recorder.

The manner in which this conflict is resolved, FAA sources told Aviation Week, may decide whether CAB issues a contributory cause finding in the case after all evidence has been collected. That such a finding was a major objective of United Air Lines was borne out by the statement read into the official record by McErlean just as the inquiry adjourned. In it, he maintained:

"At this time we think it can be safely said that this accident would not have happened had Air Traffic Control properly utilized the equipment, personnel and facilities available."

Elwood R. Quesada, FAA's outgoing administrator, apparently took a different view. In requesting CAB to acquire about 40 flight recorder tapes from airlines using Preston prior to the crash, Quesada said that data extracted from the recorder on board United's DC-8 gives reason to believe that some pilots may have been engaging in "unsafe operating practices."

FAA, Quesada said, has embarked upon its own safety examination and analysis because it believes these "operating practices" may call for changes in the over-all air traffic control system. Or, on the other hand, possible disciplinary action against airlines and pilots for violating existing Civil Air Regulations may result, he said.

Almost certainly, CAB officials here stressed, the hearing will be reconvened at a later date. Meanwhile, they said, the record will remain open and accessible. Only after the record has been closed will the five members of the CAB study the evidence and reach a conclusion on the cause of the crash.

In informal conversations, however, counsel for the interested parties ventured the opinion that this ultimate record must establish at least one of two points in order to help absolve the DC-8 pilot for overshooting Preston. A significant malfunction on the part of any visual omnirange (VOR) used by the pilot to plot the intersection would be one (AW Jan. 16, p. 38).

The other, far more complex point involves the possibility of negligence on the part of controllers monitoring the jet's progress to, and then beyond, Preston. But before negligence can even be considered a causal factor, this chain of premises probably must be proved by the evidence:

- **Collision occurred substantially** at the time and at the place indicated by the flight recorder. This would cast doubt upon the controller's statement.
- **DC-8 was being afforded radar** separation at the time its pilot was advised "radar service is terminated, contact Idlewild Approach Control."
- **FAA** requires center controllers to warn pilots of aircraft under radar surveillance of possibly dangerous situations before transferring their control to another facility. Such a warning was never radioed the DC-8.

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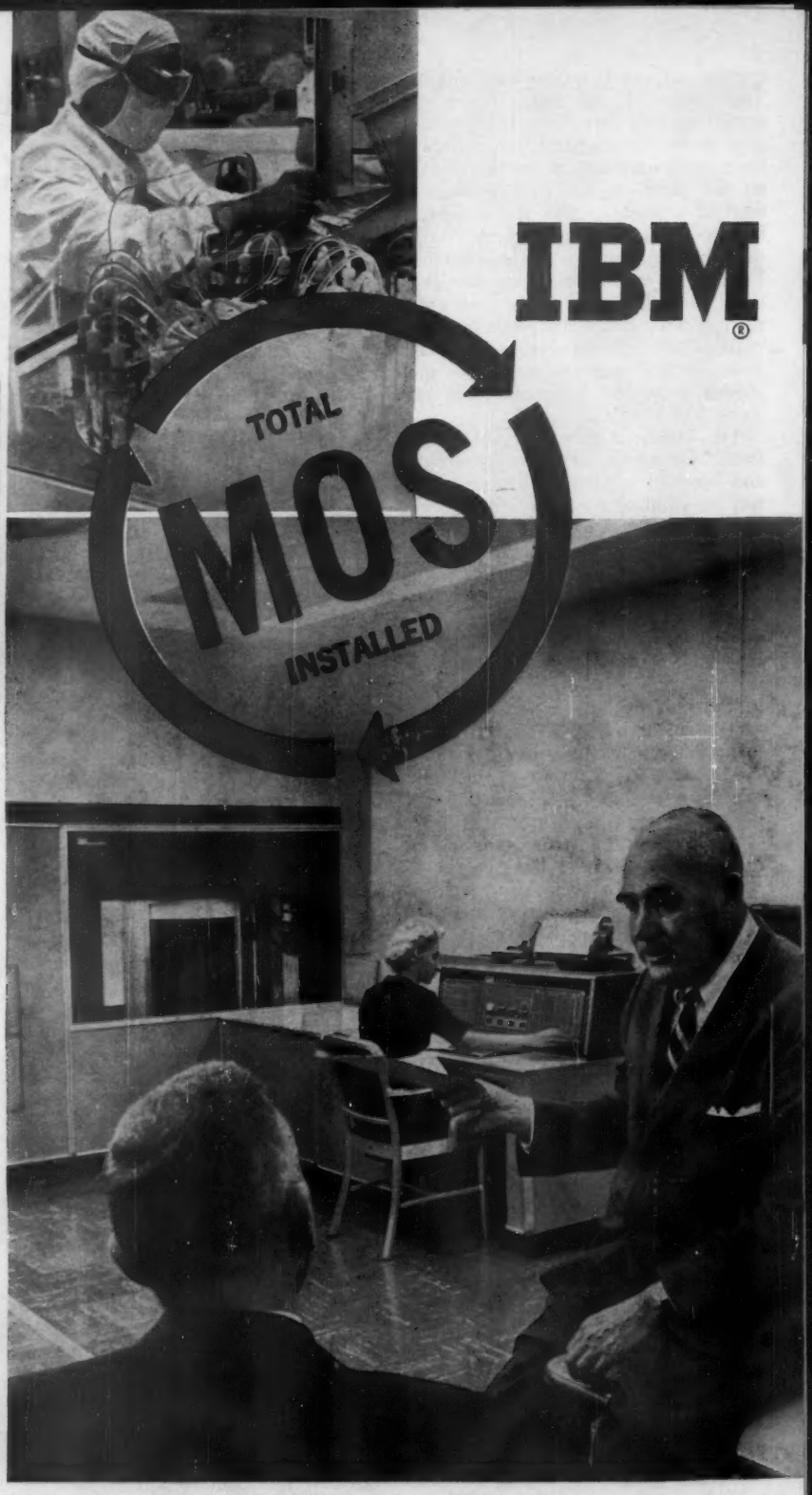

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AIRLINE OBSERVER

▶ The Netherlands will make another vigorous bid for a Los Angeles route for KLM now that the new administration has taken office. The Eisenhower Administration, succumbing to Dutch pressures for the route, agreed last month to approve the Los Angeles terminal point but was stopped short by a Treasury Department warning that the present unfavorable U. S. balance of foreign trade would be damaged further by the granting of new routes to foreign flag carriers. The Dutch promptly retaliated by furnishing figures to the U.S. showing that KLM spends more dollars in the U.S. than it takes out and will use these figures as the basis for their renewed campaign for the route.

▶ Riddle Airlines inaugurated Logair service last week with the first of several Armstrong Whitworth 650 Argosy turboprop transports it has on order. The aircraft is certificated on the basis of 88,000-lb. maximum gross, 50,000-lb. basic operating and 80,000-lb. maximum landing weights. Average stage length along the Logair route pattern flown by Riddle is 250 naut. mi. The fully fueled Argosy, which averages 240 kt. along these routes, suffers economic penalties on initial segments since all fuel weight in excess of the 80,000-lb. landing limit must be burned off prior to landing. For flight planning, Riddle assumes the aircraft will burn 3,000 lb. per hr. in cruise, 2,000 lb. in climb and 200 lb. in descent. Carrier has scheduled 30 min. for most en route on-loading and off-loading stops.

▶ New heliport being completed at Baku on the Caspian Sea coast will be the base for flights by Russia's 80-passenger, twin-turbine Mi-6 helicopter. Unveiled in 1957, the Mi-6 has been active in setting world records, but its promised introduction into passenger service has long been delayed. Baku is one of the Soviet Union's main commercial helicopter hubs. During the first half of 1960, single-rotor Mi-4s made 3,000 flights and carried 30,000 passengers between Baku and Neftyanye Kamni, an oil-producing center built on pilings over reefs in the Caspian Sea.

▶ Federal Aviation Agency tests have demonstrated that crew conversations on transport aircraft can be effectively recorded during flight through the use of an area pickup microphone with a cardioid pattern. Tests show that when a microphone is mounted on the instrument panel, adequate protection is afforded by panel shock and vibration isolators and that ambient noise levels are offset by the use of electronic noise filters.

▶ International Air Transport Assn. is conducting a survey of international clearance conditions in the Far East in its latest drive to cut red tape in border customs and immigration procedures. Purpose of the survey is to determine how far countries have gone in adopting clearance recommendations made by an intergovernmental conference held in Rome last year under the auspices of the International Civil Aviation Organization.

▶ Philippine Air Lines has purchased a turboprop Vickers Viscount from Capital Airlines for operation on its domestic routes. The carrier currently operates a fleet of three Viscounts and two Fokker F-27s in addition to piston-engine aircraft.

▶ Federal Aviation Agency has set uniform standards for identification marks on fixed-wing aircraft, requiring markings at least 12-in. high on the side of the fuselage or on the vertical stabilizer. Wing marking will no longer be required. Aircraft operators have until Jan. 1, 1966, to comply with the regulation, although all aircraft which are re-marked or newly marked after Jan. 1, 1962, must conform to the new standard.

▶ American Airlines will build its Sabre Reservation Center in Briarcliff Manor, Westchester County, New York late this year. Sabre, an electronic data processing system that will handle 7,500 passenger reservations per hour, will be linked with 1,100 reservation desks in over 60 cities by mid-1963. The system will enable American to process 85,000 daily phone calls, 30,000 daily requests for fare quotations, 40,000 daily reservations, 20,000 ticket sales and 30,000 daily interline transactions.

SHORTLINES

▶ **Air France** has increased its Boeing 707 Intercontinental service between New York and Mexico City from two to four flights weekly. The route formerly had two 707 and two Lockheed 1649 Constellation flights a week.

▶ **British Overseas Airways Corp.** reports a New York-Nassau passenger load factor increase of 27% for December, compared with December, 1959. The British carrier flew 3,893 passengers over the route last month and reports advance bookings for January and February indicate the load factor will increase again.

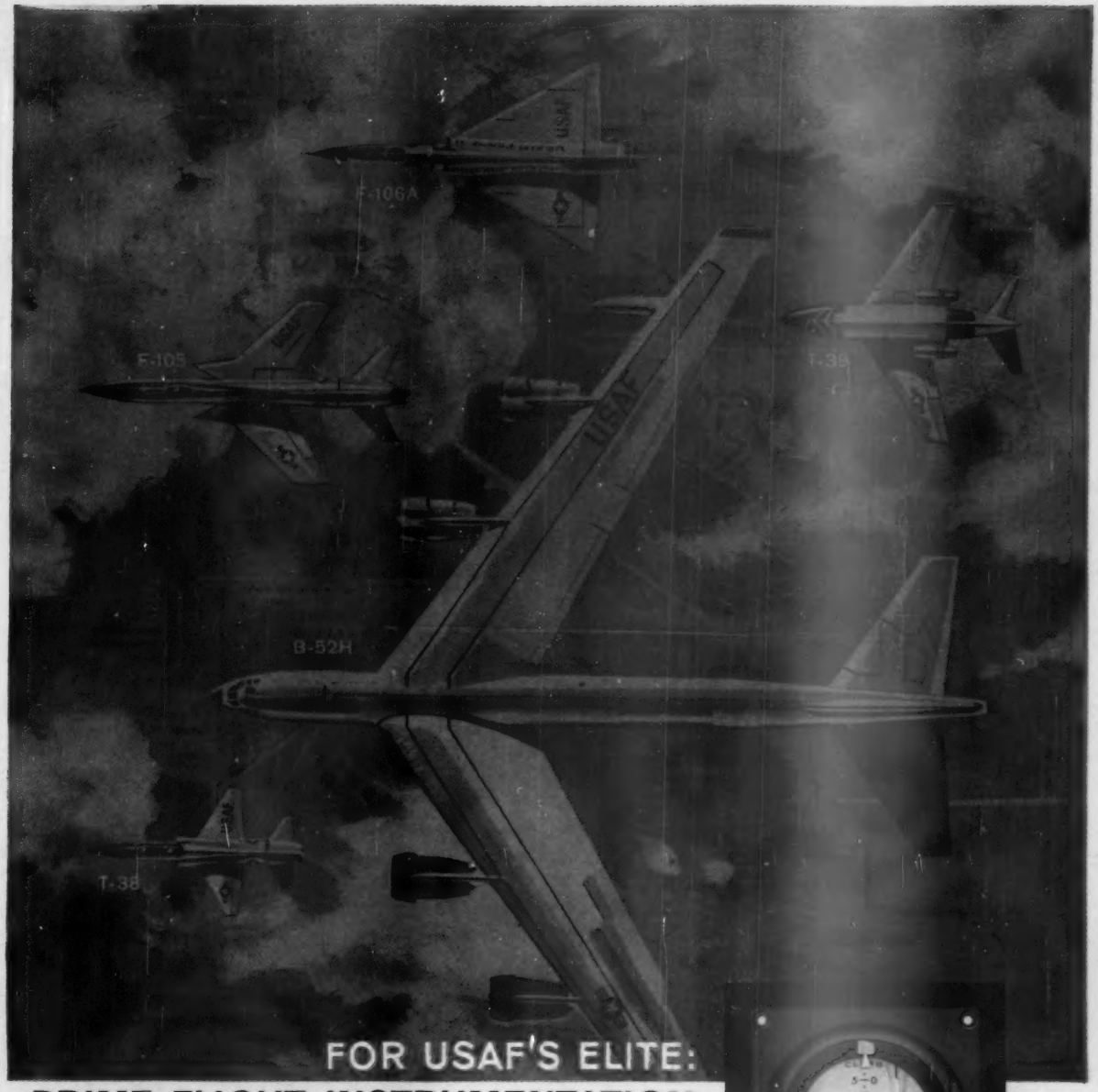
▶ **Cunard Eagle Airways (Bermuda),** Ltd., has become a member of the International Air Transport Assn., and Linea Aeropostal Venezolana, which has halted international operations, has dropped out of the association, leaving the total membership at 89.

▶ **Delta Air Lines** is scheduled to start direct Douglas DC-7 service from New Orleans to Aruba, N. W. I., Feb. 1 with three weekly flights. The service will operate via Montego Bay, Jamaica, on two flights and Havana and Montego Bay on the third, and all three will terminate in Caracas.

▶ **Eastern Air Lines** has received Civil Aeronautics Board permission to delay the start of daily round trip service between Baltimore and Tampa/St. Petersburg, Orlando and Louisville until Feb. 1 to allow the airline to complete operational arrangements at Baltimore's Friendship Airport. CAB said Eastern must operate the services in the Washington-Baltimore Adequacy of Service Investigation decision.

▶ **Federal Aviation Agency** has started construction of its new $1.75 million air traffic control center building at Palmdale, Calif. The 50,000 sq. ft. structure is scheduled to be completed in a year, with an additional nine months required to install $3 million worth of electronic equipment. Center will house 300 air traffic controllers and electronics specialists.

▶ **Mohawk Airlines** has been denied permission to fly from Buffalo to Detroit on a nonstop basis by the Civil Aeronautics Board. The Board said it would be inappropriate to grant Mohawk nonstop rights over the route while the reopened Erie-Detroit Investigation was still pending. The nonstop rights requested by Mohawk would have eliminated Erie on all but three flights in each direction on the route.



FOR USAF'S ELITE:
PRIME FLIGHT INSTRUMENTATION

For key USAF training and operational aircraft, Sperry is now producing—in quantity and to AF specifications—two most important flight instruments. The ARU-2A/A Remote Attitude Director (RAD), and the AQU-2/A Horizontal Situation Indicator (HSI), are the heart of the Air Force Integrated Instrument System developed by the Flight Control Laboratory of WADD.

The "forward looking" RAD displays attitude in pitch and roll, glide slope displacement on ILS approaches, command heading and pitch, and rate of turn and of slip. The HSI is "downward looking"—giving aircraft heading, displacement and position data relative to a prescribed flight path.

These instruments—embodying the most needed pilot information in two compact and easy-to-read panel indicators—are integrated with the Sperry CPU-4/A Flight Director Computer which converts data from a variety of sources into command information.

Meeting the critical needs of USAF for precision flight instruments is a "natural" assignment for Sperry, with its half-century of experience in aviation instrumentation for the military as well as commercial aircraft. General Offices: Great Neck, New York.

SPERRY

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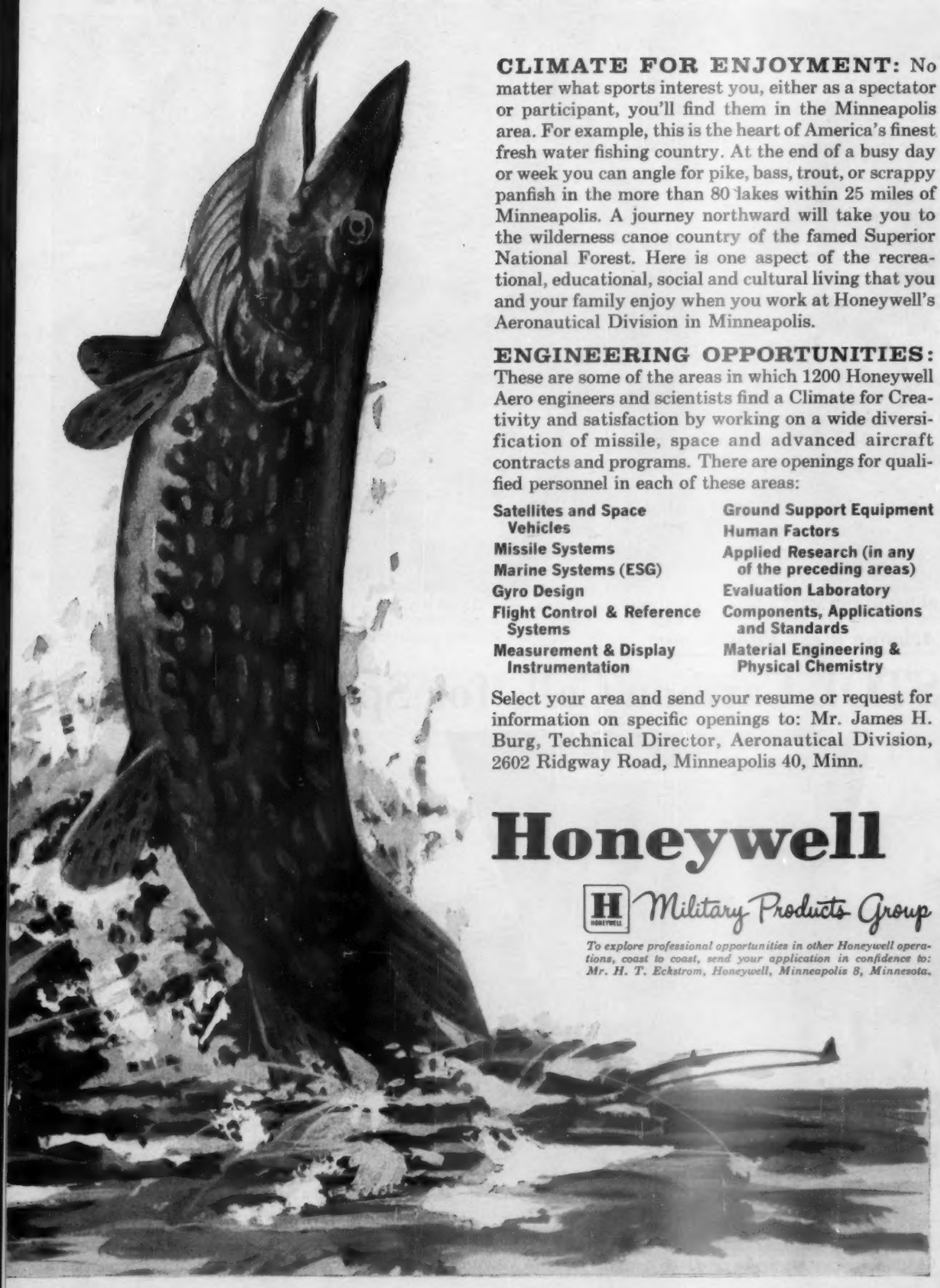
CLIMATE FOR CREATIVITY: Pictured here is the Polaris Missile for which Honeywell Aero is now producing inertial platforms. In addition, Aeronautical Division Engineers have created an Electrically Suspended Gyro for use on Polaris launching submarines. This unique gyro is potentially capable of providing accuracies never before achieved with an inertial navigation system. This project is typical of the advanced systems concepts and ideas which are being evolved and further developed into working hardware and products at Honeywell Aero.

Creativeness is not unique at Honeywell. It is widely encouraged. An engineer at the Aero Division finds himself exposed in almost all of his professional and non-professional contacts to individuals who understand, appreciate and respond to the creative individual.

Don't get us wrong—we are in business and have specifications and schedules to meet. We don't have unlimited freedom for each man to follow his every inclination. But within the framework of our business there is plenty of room for a man to exercise his imagination, drive and talents and in the process grow in professional stature and have his accomplishments recognized and rewarded.



CLIMATE FOR ENJOYMENT: No matter what sports interest you, either as a spectator or participant, you'll find them in the Minneapolis area. For example, this is the heart of America's finest fresh water fishing country. At the end of a busy day or week you can angle for pike, bass, trout, or scrappy panfish in the more than 80 lakes within 25 miles of Minneapolis. A journey northward will take you to the wilderness canoe country of the famed Superior National Forest. Here is one aspect of the recreational, educational, social and cultural living that you and your family enjoy when you work at Honeywell's Aeronautical Division in Minneapolis.

ENGINEERING OPPORTUNITIES: These are some of the areas in which 1200 Honeywell Aero engineers and scientists find a Climate for Creativity and satisfaction by working on a wide diversification of missile, space and advanced aircraft contracts and programs. There are openings for qualified personnel in each of these areas:

- **Satellites and Space Vehicles**
- **Missile Systems**
- **Marine Systems (ESG)**
- **Gyro Design**
- **Flight Control & Reference Systems**
- **Measurement & Display Instrumentation**
- **Ground Support Equipment**
- **Human Factors**
- **Applied Research (in any of the preceding areas)**
- **Evaluation Laboratory**
- **Components, Applications and Standards**
- **Material Engineering & Physical Chemistry**

Select your area and send your resume or request for information on specific openings to: Mr. James H. Burg, Technical Director, Aeronautical Division, 2602 Ridgway Road, Minneapolis 40, Minn.

Honeywell

H HONEYWELL *Military Products Group*

To explore professional opportunities in other Honeywell operations, coast to coast, send your application in confidence to: Mr. H. T. Eckstrom, Honeywell, Minneapolis 8, Minnesota.

DE HAVILLAND AC-1 Caribou STOL twin-engine transport can carry 30 combat troops or 3 tons of cargo, has maximum range of 1,400 mi.

Aviation Week Pilot Report

STOL Caribou Calls for Special Handling

CARIBOU transport can handle cargo loads up to the size of an Army Jeep vehicle.

By Larry Booda

Ft. Rucker, Ala.—De Havilland AC-1 Caribou is a simple, rugged twin-engine transport which is light on the controls and honest in its responses—but its STOL capability calling for flight unusually close to a low stall speed holds some surprises for pilots used to flying higher performance aircraft from long runways.

The Caribou is under evaluation here by the Army as a medium-size transport which can carry a substantial load in short takeoff and landing operations on rough terrain. It uses a combination of conventional high-lift, high-drag devices, rather than any radical features, to get its STOL performance. The AC-1 has a rugged structure similar to that of a carrier aircraft, and it is designed around proven engines and components to provide a high degree of reliability.

De Havilland Aircraft of Canada originally planned the Caribou for operation from unimproved airstrips in northern Canada, but the U. S. Army became interested and ordered five transports for testing. A recent order brings the total to 51 and will carry production

CARIBOU wing has a dual section flap arrangement, shown retracted. Forward part of the upper wing surface dam is shown, as is the drooped and extended outboard wing leading edge and landing gear details.

through 1962 at four aircraft a month.

AVIATION WEEK flight evaluation of the Caribou was performed at Cairns Army Air Base here, scene of most of the test program. Army testing has included flights from short, rough, dusty and muddy strips, and flights were made under desert conditions at Yuma, Ariz. Cold weather tests are currently under way in Alaska.

The Caribou's high wing has a 96-ft. 4.75-in. span, fuselage is 72-ft. 7-in. long and height to the top of the vertical stabilizer is 31 ft. 9 in. This large vertical tail, designed to provide adequate control at low speeds, is a distinguishing feature of the transport.

AC-1 is powered by two Canadian Pratt & Whitney R2000-13 engines with Hamilton-Standard 43D50/7107-0 three-bladed, full feathering propellers. One test aircraft has reverse pitch propellers for evaluation, and this feature may be ordered for operational models.

Commercial version of the Caribou has two R2000-7M2 engines. The R2000 was produced in large quantity during and after World War II for military and civil versions of the Douglas DC-4, and long experience should make it a highly reliable, easy to maintain powerplant for both military and commercial use.

The AC-1 is approved by the Cana-

CARIBOU can operate from short, unprepared fields or improvised battle area landing strips.

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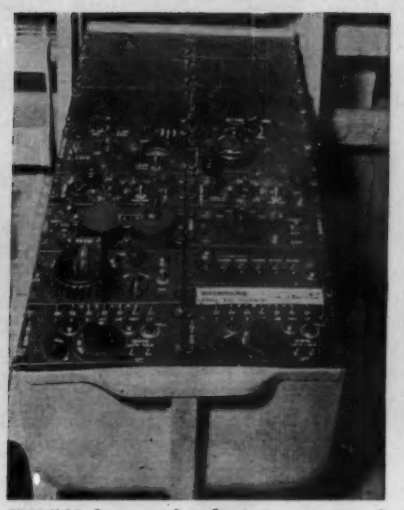


SLIDING floor panel under instrument panel has FM tactical unit, UHF ARC-55 transceiver, a VOR receiver, ADF marker beacon, an ILS, VHF transceiver and dual intercom.

dian Department of Transport and the U. S. Federal Aviation Agency for transport operation with two pilots at a maximum gross takeoff weight of 26,000 lb. Operating limitations reflect requirements for conservative climb procedures to provide safe single-engine operation and for generally conservative civil operation.

Military Difference

Military operation, however, takes full advantage of the aircraft's STOL characteristics. The cockpit is designed so one pilot can fly it easily. Only under airways-type instrument flight would single pilot operation become marginal.

A pilot used to flying from long, paved runways and landing with an appreciable speed margin over the stall speed will find flying the Caribou a radically different experience. The aircraft's full performance takeoff and landing technique calls for holding the airspeed indicator unusually close to the stall mark. Any padding of pattern and approach speed with the Caribou can cause more trouble than flirting with the stall curve.

Takeoff and landing technique calls for holding airspeed within 5-10 kt. of the stall speed. This is to gain altitude as fast as possible after takeoff and to obtain a steep approach path and prevent floating after flareout on landings. Extra speed could cause a dangerous overrun into rough or wooded terrain.

Short takeoff and landing aircraft in the light plane class are not new. The pre-World War II, German-built Fieseler FI-156 Storch had a minimum speed of 31 mph. and normally landed at 40 mph. and several other light STOL aircraft have been flown since then. But application of STOL characteristics to a larger, multi-engine transport is relatively new.

The Caribou's high-lift system is centered on the wing, which tapers from a 12-ft. chord at the root to 5 ft. 8 in. just inboard of the curved wingtips, giving it a 10-1 aspect ratio. Wing area is 912.4 sq. ft., 285 sq. ft. of it devoted to the high-lift area.

High-lift device is basically a sectionalized flap system in which two flap sections span the trailing edge of the wing from root to nacelle and nacelle to aileron. When the fore and aft flap sections are fully down, they curve around approximately 90 deg. The aft end of the nacelle droops with the flaps to provide drag, and more drag is added by flat plates on the main gear struts to keep forward speed low while the high-lift system is generating lift.

Slots between the wing trailing edge and between the two flap sections keep air flow smooth over the flaps. From the nacelle out, the dual flaps extend 7 ft. From there out, the aft flap section functions as both flaperon and standard aileron. It droops part way when the flaps are down, but it also responds to control movements.

A flettner trim tab is hinged to the right outboard aileron, and geared tabs are hinged to both left and right outboard ailerons. An aileron-rudder interconnect tab is hinged to the right inboard aileron and provides increased dihedral effect in straight sideslips at low speeds.

Because of the exaggerated effect on trim when the flaps are lowered, there is coordination between the flaps and the horizontal stabilizer, which can move through four degrees to compensate for the change in pitch forces.

A fence to reduce spanwise flow is on top of the wing 7 ft. outboard from the nacelle at the dividing line between flaps and flaperon. Beginning another 7 ft. outboard, the leading edge is extended and drooped slightly. Fence and drooped edge are designed to provide better natural stall warning.

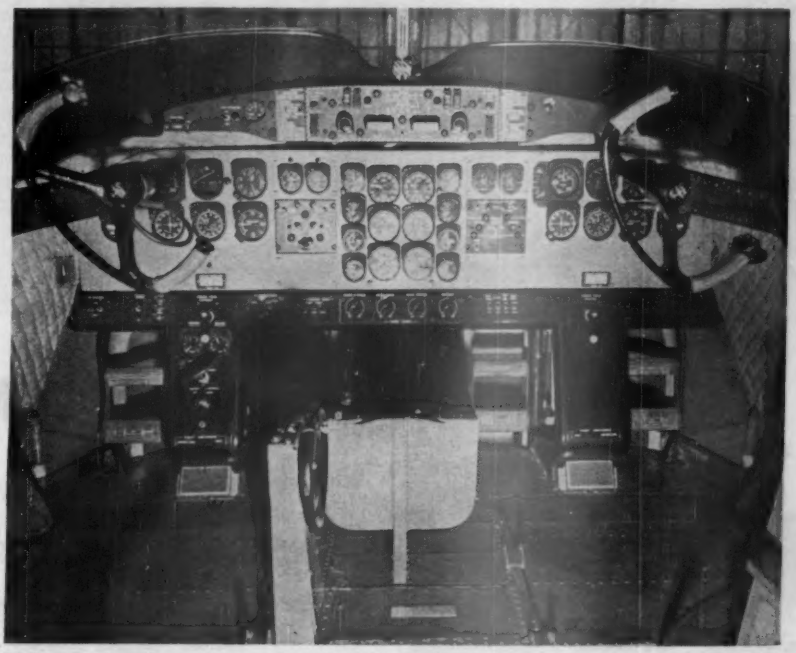
Larger Empennage

For adequate control at low speeds, de Havilland has given the Caribou a larger than usual empennage. The rudder, for example, has 60% more surface than the DC-7 rudder.

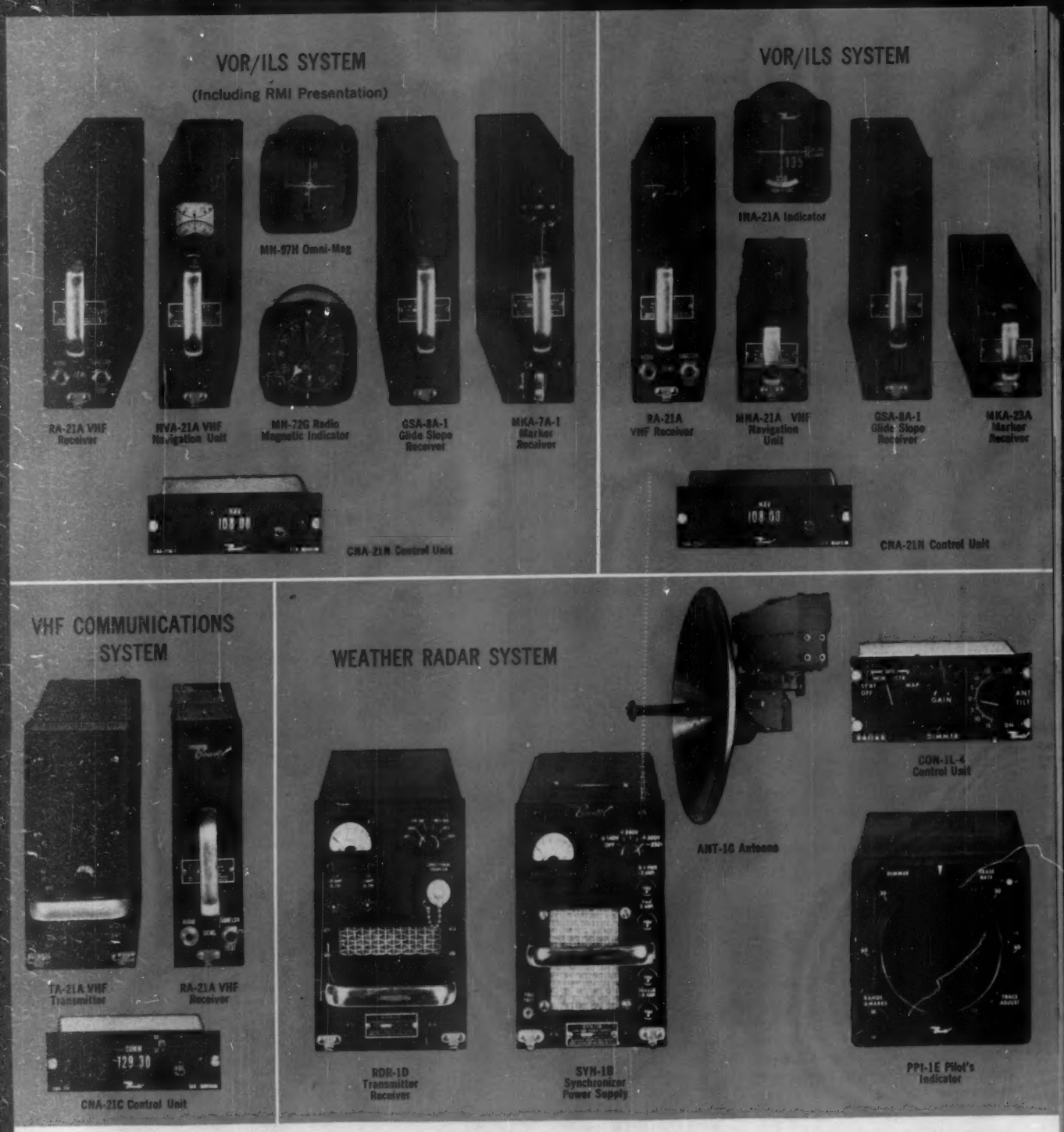
The AC-1 can be equipped for a variety of missions, and carry 8,000 lb. including fuel, oil and crew. It can carry 22 soldiers for air drop or ground delivery. Jumps are made through the rear ramp, which also is used for loading.

Cabin has two aft side doors, but there is not enough separation to permit paired jumping through them. Fuselage deck is plywood because it minimizes damage to metal flooring and can be easily replaced. Cabin also can

Military Editor **Larry Booda** was a naval aviator for 22 years, flying a variety of aircraft from catapult seaplanes to multi-engine land and seaplanes. His 3,600 pilot hours include the Royal Air Force advanced instructor's course at the Empire Central Flying School in 1943, where he checked out in 14 different RAF aircraft. He holds a commercial pilot's license with instrument rating.



COCKPIT view shows pilot and copilot flight instrument groups, engine group and fuel control. Sliding floor panel in center contains communication unit controls.



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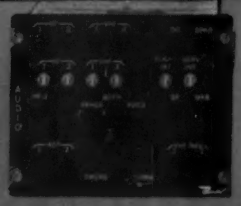
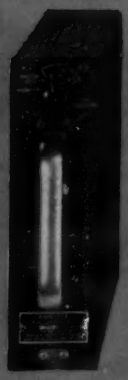
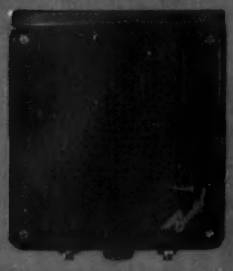
AUDIO EQUIPMENT



CNA-2C-1 Audio Selector Panel and Amplifier



AMA-10A Passenger Address Amplifier



MI-51B Cockpit Loudspeaker and Amplifier

LA-178T Audio Amplifier

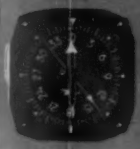
ADF SYSTEM

LPA-71A Flush Loop Antenna

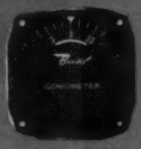
GMA-71B Goniometer (Direct reading dial for instrument panel mounting.)

DFA-70B-1 ADF Receiver

CNA-70C Control Unit



MN-72G Radio Magnetic Indicator (RMI)



GMA-71A Goniometer (Provides outputs for operation of two RMI's)

DOPPLER NAVIGATION SYSTEM

DRA-12A Frequency Tracker

RTA-12A Transmitter Receiver

INA-12A Indicator

CNA-12A Control Unit

ANA-12A Antenna

NAVIGATION COMPUTER SYSTEM

CPA-24A Navigation Computer

CNA-24A Computer Controller

ANTENNAS

MS-192C VOR Antenna

ANA-20A VHF Comm Antenna

MN-82A Glide Slope Antenna

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This is the Division that laid the foundation for a large part of America's current missile/space technology. Many of today's breakthroughs in aerodynamics, high speed flight, inertial guidance, large rocket boosters, materials, and manufacturing methods and equipment stem from original development work done by the Division.

This is the Division where the scientists of the Aero-Space Laboratories are seeking the keys to satellite rendezvous, refined trajectory analyses, space environment knowledge, lunar morphology, and materials to withstand space conditions.

This is the Division where intensive studies are underway on manned and unmanned space exploration vehicles, anti-ICBM projects, and information processing systems.

This Division is contributing vitally to America's rapidly developing space programs.

THIS IS THE

SPACE & INFORMATION SYSTEMS DIVISION

NORTH AMERICAN AVIATION, INC.

Caribou Specifications

Wing Span	96 ft. 4¾ in.
Length	72 ft. 7 in.
Height (Tail)	31 ft. 9 in.
Height (Prop tips)	13 ft. 1 in.
Empennage width	36 ft. 0 in.
Prop ground clearance	21.9 in.
Cabin length, inside	29 ft. 9 in.
Cabin width, inside	6 ft. 1 in.
Gross weight	26,000 lb.
Empty weight	
Aircraft minus fuel, oil and crew	18,000 lb.
Maximum fuel load	722 gal.
Performance	
Maximum cruise speed, normal	177 kt.
Max. speed in turbulence	125 kt.
Max. landing speed	76 kt.
(Note. Following stall speeds are for FAA and DOT approved operations. Military operation stall speeds are less and are explained in text.)	
Stalling speed, gear and flaps up	72 kt.
Stalling speed, gear and flaps down	54 kt.
Rate of climb, max. cont. rated power, two engines	1,575 fpm.

carry litters as an ambulance or cargo loads as large as a Jeep vehicle.

Entering the cockpit from the cabin there is a high step, reminiscent of seaplane flight decks. Generally, the Caribou flight deck is less cluttered and roomier than most two-pilot aircraft. Space can be increased by sliding the tracked central electronic selector pedestal under the instrument panel.

Cockpit Visibility

Both pilot and copilot seats are comfortable and fully adjustable. Inboard arm rests are retractable. There is only a slight tendency to hit one's head on sharp protuberances on entering a seat. Visibility from each seat offers little more than a standard transport. The sill over the instrument panel is high, and forward visibility can be improved only by putting the seat up and adjusting the rudder pedals back to meet the feet. There is a small window overhead on each side to improve the side view during a turn, and side windows permit observation of the engines.

Rudder pedals are adjustable together by a crank on the pedestal between them. There need be no concern about the pedals being matched when the rudder is centered, since the pedals travel in adjustment together.

As in most high wing configurations, the throttle, mixture and propeller control quadrants are located overhead in the center of the cockpit roof. This arrangement permits shorter, more direct linkage with the engines. All engine and control surface linkage is by means of push rods.

There are no unusual features about the toe brake rudder pedals or the W-type wheel control column. Microphone, intercom and aileron trim buttons are located on each wheel.

The cockpit area has these features:

• **Overhead console** has throttles, gust lock, landing gear, mixture, propeller speed, friction for mixtures and throttles, flaps, rudder trim and carburetor heat controls, plus switches for ignition, landing and taxi lights and carburetor alternate air.

• **Front instrument panel,** both pilot and copilot sides, uses Army T-system for the flight group: upper row has airspeed, artificial horizon, altimeter; lower row has VOR indicator-selector, compass and ADF indicators, vertical speed. On the pilot's side, the turn and slip indicator is to the left of the lower row, and on the copilot's side it is to the right.

• **Center panel section** left row has, top to bottom, thrust indicator, carburetor and air temperature, cylinder head temperature, oil temperature; second row from left has, top to bottom, manifold pressure, tachometer, fuel and oil pressure; third and fourth rows are the same as the two rows on the left. Instruments to the left are for the left engine, and rows to the right are for the right engine. Low oil pressure warning lights are also on this panel below the instruments.

• **Overhead on the left** are the auto feathering switch and indicator light, clock, landing check list; overhead on the right are takeoff check list and doors-unlocked light.

• **Left of the center panel** is the fuel control panel; to the right of the center panel is the AC-DC power and deicing panel.

• **Between the pilot's rudder pedals** are cabin fresh air handle, cockpit fresh air handle, parking brake handle, hydraulic low pressure lights, hydraulic pressure indicators.

• **Sliding floor panel** has the FM tactical unit. UHF ARC-55 transceiver with 1,750 frequencies, two VOR receivers, an ADF receiver, a marker beacon, a glide slope ILS, a standby VHF T366-A five channel transceiver and a dual intercom amplifier which can be bypassed.

Elevator trim wheel is at the right of the pilot's seat.

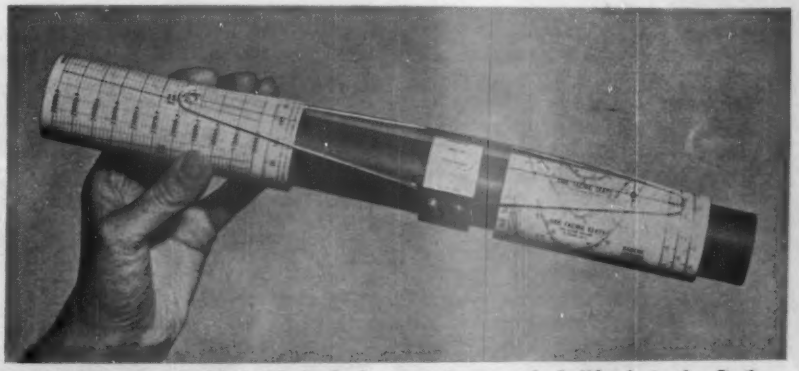
Fuel system is designed for simple operation and is well within the capability of one pilot. Storage is in two main tanks, one in each of the outer wing sections. Each tank consists of ten rubber cells and holds 361 gal. All the cells drain by gravity into the No. 1, or inboard, cell, where there is a submerged booster pump. Fuel management is so arranged that in normal operations it is a hands-off system, and in emergency conditions any combination can be rapidly selected.

For the AVIATION WEEK evaluation, the Caribou was fairly light—23,000 lb.—and the temperature was 72F. Altitude of the Cairns field is 305 ft. Procedures involved in the flights are for military operations and bear little resemblance to those prescribed by FAA and DOT for transport operations. Considerable practice is considered necessary to master the AC-1 full performance technique, even for pilots experienced in STOL work.

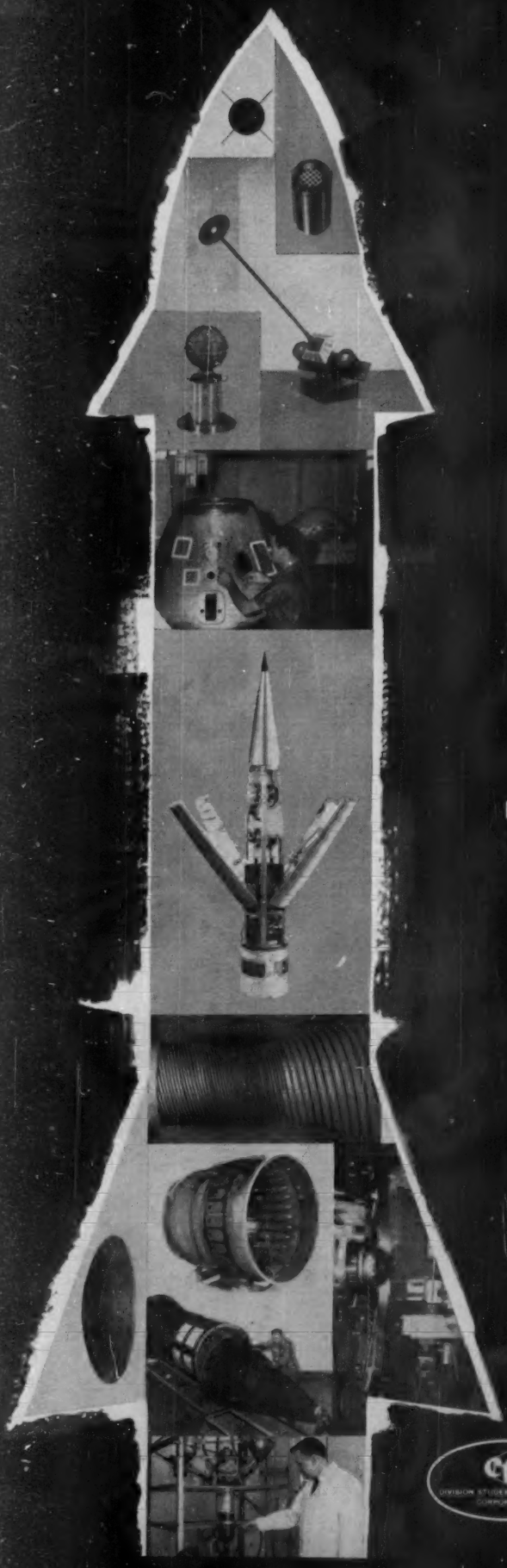
Preflight preparation calls for the usual pilot check of selected major flight systems, relying on efficient ground crew work to make sure all the aircraft's complex systems are in proper order. Prestart check in the cockpit is thorough, but engine starting procedure is standard, with throttles wide open and mixture in idle cutoff until propellers have turned through five revolutions for the first start of the day, or three for subsequent starts. Engines are then primed intermittently with the ignition on until there is a positive start, when mixture controls are moved to normal.

Caribou has no particularly unusual features in its pre-taxi, engine and final pre-takeoff checks.

From a position at the end of the



DE HAVILLAND cylindrical slide load adjuster replaces standard sliderule in the Caribou. Chief advantage of cylindrical type is that it gives a step-by-step indication as loading progresses, making possible immediate adjustments if center of gravity or weight and moment limits are exceeded.



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runway, lined up with the runway and with half flaps, the brakes are kept on and the throttles advanced until 50-in. HG of manifold pressure and 2,700 rpm. are reached. On releasing the brakes, nosewheel steering is maintained by use of the wheel on the left side of the pilot position.

First AVIATION WEEK flight involved a medium performance takeoff. For the pilot not accustomed to this aircraft, flying speed is reached within a surprisingly short interval. Procedure calls for pulling the yoke back all the way, although this runs against normal flying instincts.

If an initial climb speed of 70 kt. has been called for, the yoke must be kept far aft and the nose high, yet the 70 kt. speed is easily exceeded. With proper coordination, liftoff occurs at about 48 kt. after a ground run of about 500 ft. into a 10-mph. headwind. Full performance run is 540 ft. with no wind and 420 ft. with 10-mph. headwind, and a 50-ft. obstacle can be cleared in 1,020 ft. with no wind and in 845 ft. into a 10-mph. wind.

It is during the takeoff that limited visibility over the nose is noticed most, for with the high attack angle and climbing attitude the forward view is completely blocked.

Takeoff power may be maintained for a maximum of five minutes. Maximum continuous power for climb is 42.5-in. HG and 2,550 rpm. at sea level, and proportionately less manifold pressure for higher altitudes.

Climbing Speeds

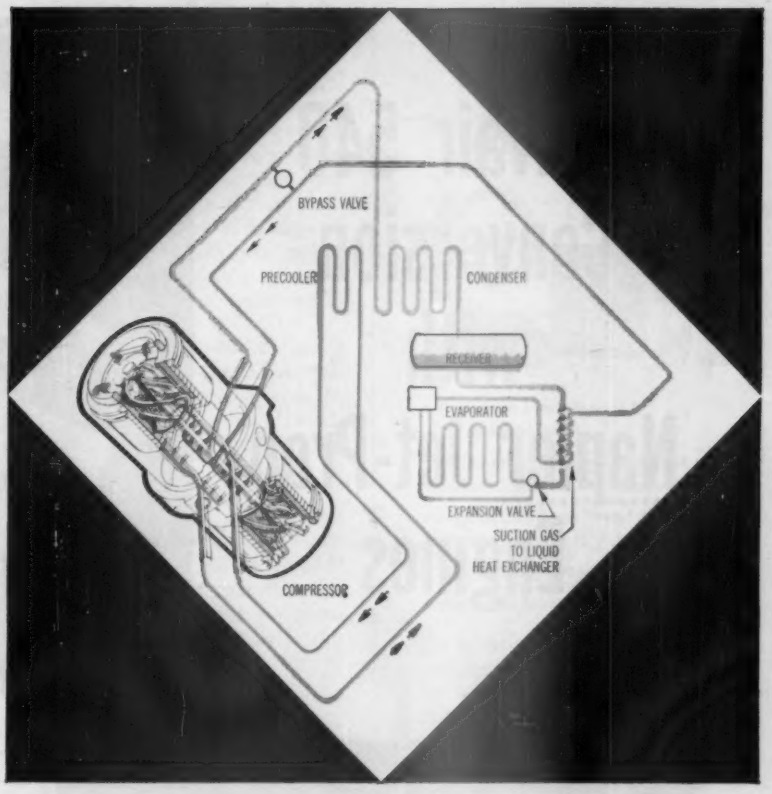
A wide range of climbing speeds is available because at lower speeds, the jet exhaust augmenter tubes keep cylinder head temperatures within operating limits. Engine nacelles have no cowl flaps.

For full performance climbout in hilly country, forward progress can be held to a minimum and climb to a maximum.

Optimum climb speed at full load of 26,000 lb. and aircraft clean is 94 kt., resulting in a 1,575-fpm. rate of climb at sea level. Optimum climb speeds with lighter weights are lower, and rate of climb is greater. Single engine climb at maximum weight at sea level is 345 fpm.

After leveling off and setting a modest cruise speed of 140 kt., it is immediately apparent that this aircraft is very light on the controls. Although it is not as light as a Beechcraft D-18 class aircraft, finger tip control is still possible in relatively smooth air. In executing rapid turns, however, almost full throw of the ailerons is necessary, and then the rate of roll is slow.

Rapid changes in altitude also require a little muscle on the yoke. However, control pressures are a small frac-



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Convair 540 Conversion with Napier Jet-Prop Engines

Convair 540s undergoing modification with Napier Jet-Prop engines at AiResearch Aviation Service, the most experienced company in the modification of pressurized aircraft.

AiResearch Aviation Service converts Convair 340s and 440s into high performance airliners and executive aircraft with Napier Jet-Prop engines specifically designed for the Convair 540.

With over-weather cruising speed of 326 mph and payload (range capacity of 60 passengers for 800 miles or 10 executives transcontinental nonstop), the Napier Jet-Prop 540 provides a smoother ride at greatly reduced noise levels and improves economy of operation in airline or business transport.

An AiResearch auxiliary gas turbine installation (optional equipment) makes the Convair 540 self-sufficient on any landing strip. The on-board unit provides complete engine starting and all power for ground air conditioning and preflight checkout.

Installation of the 3500 eshp Napier "Eland 504" Jet-Prop engines with four-bladed propellers includes structural modification to engine nacelles, new instrumentation, and electronic and radio system modification in minimum down time.

Conversion of Convair 340s and 440s to Napier-powered Jet-Prop 540s is performed exclusively at AiResearch Aviation Service, the most experienced company in the modification of Convair 240s, 340s and 440s into executive aircraft and luxury airliners.

Employing more than 600 of the most highly trained and experienced engineers, technicians and craftsmen in the industry, AiResearch performs all design, engineering, fabrication and installation work in one location to meet the conversion, modification, maintenance and overhaul requirements of any aircraft.

Write, wire or telephone today for complete information regarding your Convair 540 conversion with Napier Jet-Prop engines.

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THE GARRETT CORPORATION AiResearch Aviation Service Division

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tion of those of the old B-24, for example.

Maneuvers other than those in normal transport operations are limited to a maximum speed of 127 kt. Steep turns can be flown easily maintaining altitude by placing the nose on the horizon properly, or by flying on instruments, the latter being easier.

Stalls were performed power-on, power-off, clean, with half flaps, with full flaps and gear down. Although the stall characteristics are honest and easily identified, a stick-shaker warning device which operates at 7 kt. above stalling speed is prescribed for transport work. After one try to see how it worked, the device was shut off during the AVIATION WEEK flights.

Stall in the clean condition, that is with flaps and gear up, indicated a wide curve, with full aileron control even at full stall. With power on, full stall was reached clean at 56 kt., with power off at 62 kt. Radical full throw movements of the ailerons and rudders are necessary to keep wings level with yoke full back in this condition.

With power on and yoke nearly all the way back, maneuverable flight can be maintained a few knots above stall speed.

Stalls with half flaps are made at lower speeds but with practically unchanged characteristics.

Differing Characteristics

Stalls with full flap and gear down, as would be the case in a full performance landing, produce different characteristics. The nose, for instance, goes little above the horizon, and full stall does not occur until 46-48 kt. Control can be maintained as in other conditions.

To approach the buffet area of the stall requires effort, which is why the Caribou is considered an honest aircraft. No experienced pilot need ever be caught near it, but if in performing full performance maneuvers he does flirt with this regime, he is provided with adequate warning.

Recovery from a stall in every instance is effected by simply pushing the yoke forward to lower the nose and gain airspeed, but if altitude cannot be sacrificed, takeoff power can be used instead.

Feathering a propeller and stopping an engine in flight involves no unusual procedures. However, what happens when this is done is unusual. The multi-engine pilot gets ready with firm grasp on the wheel and feet firmly on the rudder pedals. However, it is soon apparent that little toe pressure is needed to make up for the yaw, and little extra hand control is required on the yoke.

After trimming for single engine flight, turns can be made into the dead engine with impunity, a procedure not to be recommended for most multi-engine aircraft.

Landing approach is not standard—advantage is taken of steep glide angles. The nose is pointed down sharply to maintain flying speed and to prevent premature stall when the flare is made for landing. Touchdown is made only slightly nose high, with the attitude almost flat. The nose wheel is allowed to touch down immediately, and brakes are applied. Landing rolls are the same as for takeoff under equal wind conditions.

For maneuvers under 100 kt., and it is in this area where the AC-1 will operate a great portion of the time, an airspeed meter calibrated every 10 kt. between 50 and 100 kt. would seem advantageous. Present installation is marked for only 50 and 100 kt.

The Caribou appears ideally suited for operation into and out of short, rough fields. It carries an appreciable load and offers no flight characteristics which would complicate the problems of the pilot operating under field conditions.

CG Calculator

To simplify Caribou operations in the field, de Havilland has provided a new cylindrical calculator (see p. 63) for fast, easy weight and balance computations. Center of gravity travel for the aircraft extends from a 26% forward CG limit at 21,000 lb. uniformly aft to a 31% forward limit at maximum gross weight of 26,000 lb. The aft CG limit is 41% for all weights. Loading stations are plainly marked on the interior bulkheads. Fuel and oil load is at the center of gravity.

There are separate oil systems for each engine. Provision is made for oil dilution in cold weather operations.

Basic Caribou electrical system is a direct current, single wire, 28-v. installation. A dual inverter 115-v., 400-cycle system services the radio group. All switches, fuses and circuit breakers are readily accessible in the cockpit area. For single pilot operation, in marginal or instrument weather, a knowledgeable observer or crew chief would be a valuable crew member for management of all the emergency systems.

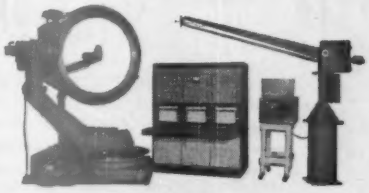
Hydraulic power at 3,000 psi. is supplied by engine-driven pumps to operate the landing gear, flaps, wheelbrakes and the nosewheel steering mechanism. For emegency or normal service there is a hand pump on the deck to the right of the pilot.

This can be used for normal operation if desired. When used if the powered system fails, the hand pump draws fluid from the emergency reserve level of the hydraulic reservoir. Reservoir is easily reached for refilling at the left rear of the cockpit.

If normal and emergency hydraulic

Boresight Accuracy

Tested Automatically



- Tests Type I and Type II to MIL-R-7705A(ASG)
- Automatically records boresight error, percent transmission, antenna patterns
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The effectiveness of the finest radar tracking system can be destroyed by the variations in refraction of the radar beam as it passes through the plastic radome. The CTI Automatic Radome Boresight-Error Measuring System assures fast, accurate measurement of the radar beam deflection as a continuous function of the antenna position. Three recorders plot the magnitudes of the horizontal and vertical error components, plus the total vector sum of the beam deflection angle, directly in milliradians. Rate of change of beam deflection angle, essential to fire control and missile applications, is readily available from the recordings. Percent transmission through the radome is measured and recorded directly. Antenna patterns are plotted with, or without, radomes. This high accuracy continuous automatic testing detects discontinuities overlooked by manual methods. The complete operation is controlled from the master console. The Model 150C, pictured here, is available for frequencies from S through K_a bands and infrared. With five years of world-wide proof of performance, the CTI Automatic Boresight-Error Measuring System is another example of CTI's advanced leadership in meeting the needs of modern electronics technology.

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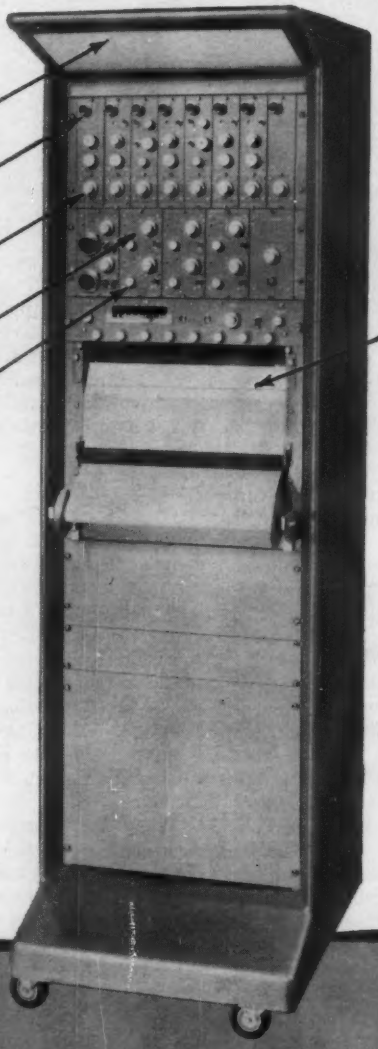

Illuminated canopy

Type 9800 series input couplers provide all input, control and balance functions. Input available both front and rear.

Type 481 Preamplifier provides sensitivities from one microvolt to 5 volts per mm.

Type 482 power amplifiers—may be used without preamplifiers for up to 10 mv/cm sensitivity

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504-A paper drive—speeds from 1 to 250 mm/sec. Electrical speed shift 1 to 250 mm per minute available. Zero weave high precision drive, 850 ft. capacity (heat or electric) 1500 ft. (ink). Front loading, with full unobstructed record visible from front.

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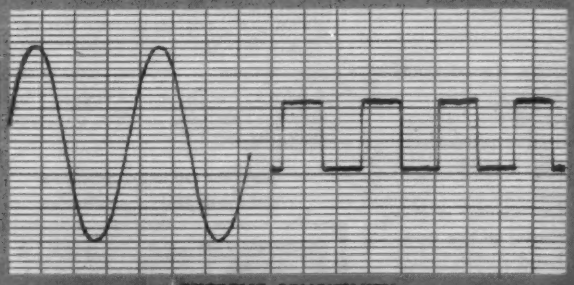

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systems fail, the main landing gear can be dropped by gravity, and the nose gear can be blown down by a single-shot compressed air charge. Emergency braking also is by compressed air.

Two combustion systems supply heat to the cockpit area and the cabin area. Windshield de-icing is done by electric heating.

Fire detection and extinguishing systems provide for control in three zones —one forward of the auxiliary firewall, another in the accessory section between the auxiliary and main firewalls, and the third in the wheel well compartment. Extinguishing agent is Freon-13B1. There are separate detection and extinguishing systems for each heater.

Each pilot position is equipped with a relief tube fastened under the seat, and one for passenger use is located aft of the passenger door on the right side.

Emergency escape provisions are made for the flight and passenger compartments. In the passenger area, escape can be made from the two passenger doors, the jettisonable cargo door and through the jettisonable central hatch on the left side. Crew can escape through a top hatch and a lower hatch, which is intended primarily for use with parachutes.

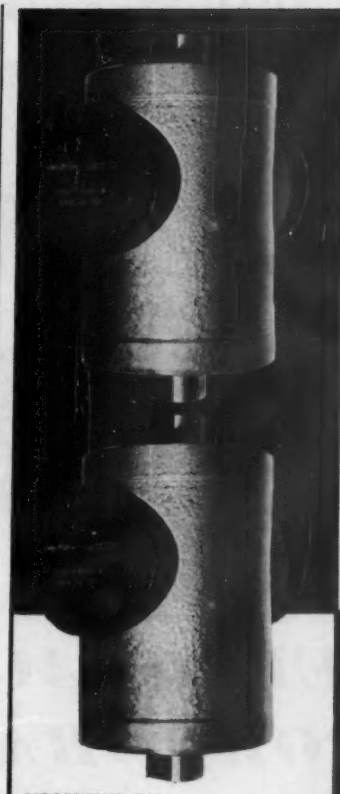
Each main landing gear consists of two 11 x 12 wheels with disk brakes and tires inflated to 38 lb. psi., an oleo-pneumatic shock strut, a drag strut and an actuator which retracts the gear into the engine nacelle. The strut partially compresses on retracting to allow the unit to fit into the wheel well. This main gear has been tested successfully at sink rates of 14 fps., and it is designed to take 30 fps.

The steerable nose wheel has two 7.50 x 10 wheels mounted side-by-side attached to an oleo-pneumatic shock strut. When the gear is down, the aft door is shut. The nose wheel is steerable through 60 deg. to either side, and the Caribou can turn in place, pivoting on the outside wheel of the main gear.

De Havilland to Build Transall Propellers

London—De Havilland Aircraft Co. will supply propeller equipment for the three prototype Transall C-160 transports under a contract worth nearly $1.4 million.

De Havilland says the 18-ft. propellers will be substantially larger than any yet made in Great Britain. The Transall, powered by two Rolls-Royce Tyne turboprop engines, is scheduled to make its first flight in 1962. It is being built for the French and German air forces by a consortium of companies in France and Germany, including Nord Aviation, Weserflugzeugbau, Hambergerflugzeugbau and Buro Blume.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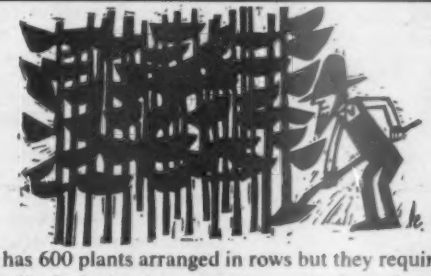
PROBLEMATICAL RECREATIONS 50



A farmer has 600 plants arranged in rows but they require an irrigation ditch. He finds that he must take out 5 plants from each row. He can then make 6 more rows. Find the original number of plants in each row.

—Contributed

Bulletins describing audio channel shifters and restorers for use with double or single-sideband radio systems are available from our Westrex Communications Equipment Department, 540 W. 58th St., New York 19, New York.

ANSWER TO LAST WEEK'S PROBLEM: The first student will have said "No," whether or not he is studying liberal arts. Hence the second must be telling the truth, and hence is not in liberal arts. If the third is not in liberal arts, then the first is, and vice versa. There is only one liberal arts student. If the third is in liberal arts, then he's lying and the first really is not in liberal arts. But the word "really" implies he said he was a liberal arts student, which is impossible. Hence the third cannot be in liberal arts, and thus the first is.

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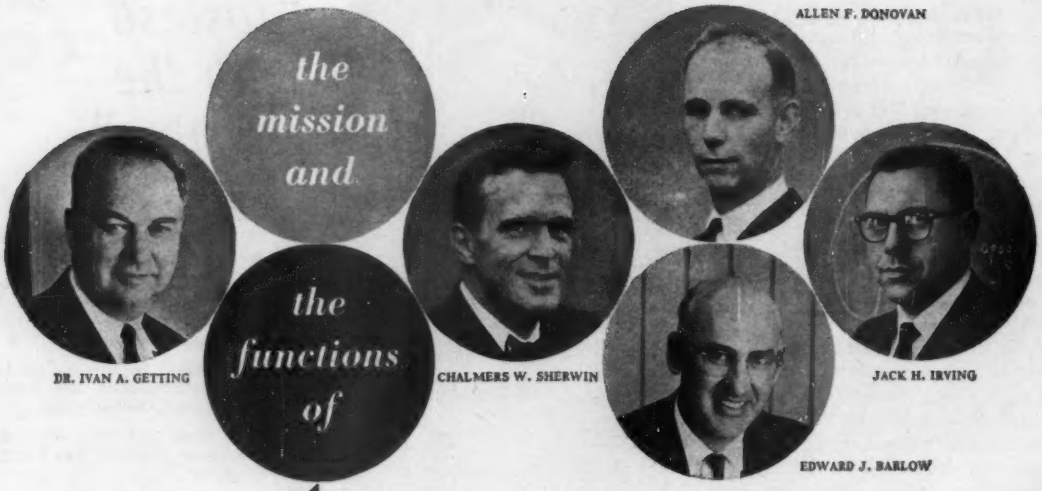
Beverly Hills, California



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Military Studies Ground Effect Vehicle

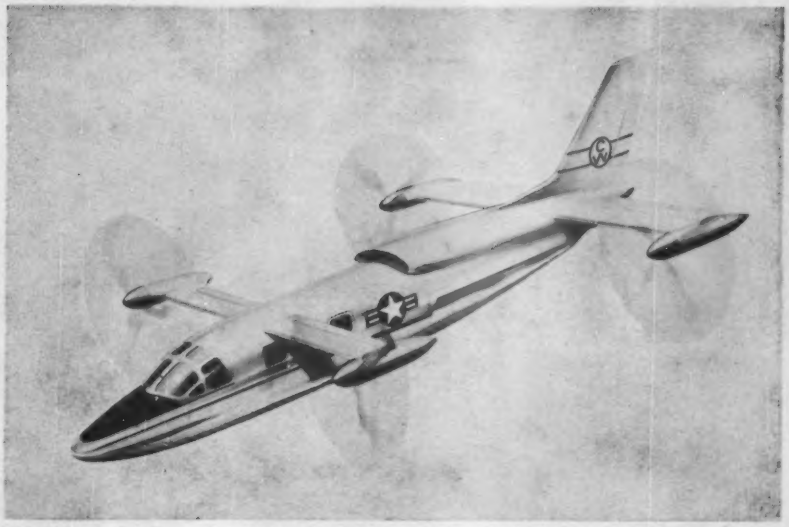
By David A. Anderton

Detroit—Construction of first useable, practical ground-effect machine (GEM) for a military mission could start this year with funding available for Fiscal 1962 appropriations.

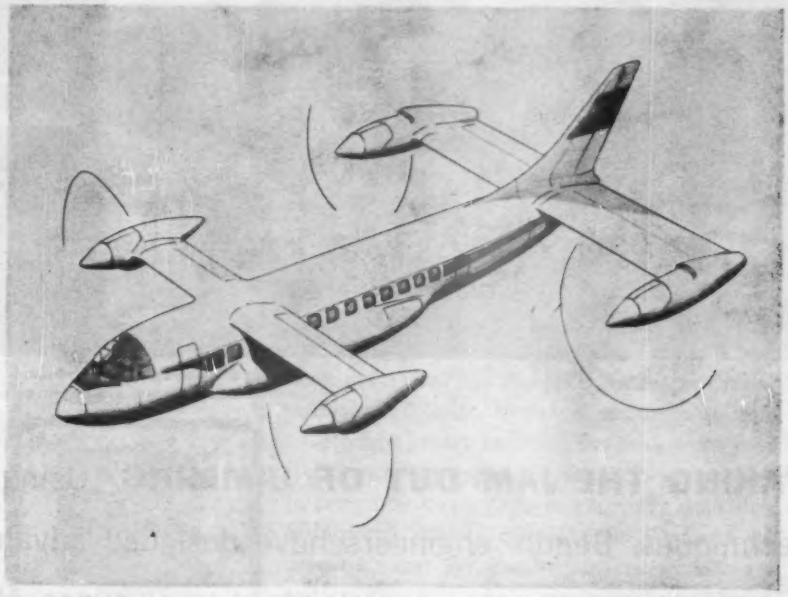
GEM progress during the past two years has been rapid enough to justify design studies and component procurement leading to an amphibious support machine, said Lt. Col. J. L. Wosser, USMC, at the 1961 Society of Automotive Engineers International Congress here.

Vehicle would be designed to carry a 30,000-lb. payload, would weigh approximately 60,000 lb., and have a cruise speed of at least 60 kt. With a total of 4,800 installed horsepower, cruise altitude would be about two feet and hover height above three feet. Overall vehicle width would be about 40 ft., length about 68 ft., and effective diameter of the vehicle, 50 ft.

Currently supported by 34 military contracts ranging from fundamental flow studies through procurement of complete test vehicles, the field of ground effect machines has developed rapidly during the past three years. There are now at least 38 known vehicles existing either in large model form or in full-scale operational or experimental configuration. Research spending has been relatively small—about $2.5 million per year—but the results produced by that relatively small investment have surprised everyone by their magnitude.



DORSAL air intake on latest drawing of the Curtiss-Wright Model 200 VTOL aircraft denotes design change from four rotating combustion to two turbine powerplants.



MODEL 300 short range transport VTOL design also is changed to utilize turbine engines. Propellers will be interconnected in order to provide engine-out control.

Amphibious Mission

Most of these results included one salient point about the GEM: It works best where it has no competition. If it is designed to one mission, then it can be effective, said M. M. Cutler, of Wright Aeronautical Division. Right now, that mission looks like an amphibious one, with the GEM serving as an off-shore supply vehicle.

Much current GEM effort at Wright and other development organizations is aimed at the LOTS (logistics over the shore) mission, which calls for cargo resupply over a secured or lightly defended beach. The supply route originates at the widely dispersed ships of the assault force, stationed perhaps 30 to 100 mi. off-shore. The sea is running with occasional whitecaps, but is not breaking. There is a swell, with wave height of three to five feet from crest to trough and wavelength of 150 to 300 ft. trough to trough.

In such a situation, a 30,000-lb. payload GEM would have a delivery rate to the beach about equal to that of a Sikorsky S-60 helicopter, Cutler pointed out, plus an expected advantage of more economical delivery.

But many problems remain, and not the least is the consensus that U. S. GEMs are lagging behind the pioneering developments of the British by about one year. Peter G. Fielding, of Booz-Allen Applied Research, Inc., pointed out that Saunders-Roe stole a march on the entire field with its construction of Cockerell's Hovercraft, and is now well along with construction of a second vehicle aimed at a commercial market. The SRN-2 Hovercraft is designed to carry 68 passengers or about ten tons of freight at a 70-kt. cruise speed.

Fielding said that British developments, including S-R, Vickers-Armstrongs, Folland and Norman-Britten, were sponsored solely as commercial ventures by British industry. There is no military money in the contracts; the aim of the designers has been to get useful, money-making commercial machines to sell primarily to the British Commonwealth.

In contrast, it is difficult to justify existence of a GEM on a commercial

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basis in the United States, primarily because transportation here is so simplified by roads, railways and runways. But in specialized applications, where mixed terrain presents a major barrier to conventional vehicles, the GEM can come into its own.

Cutler said the low "footprint" pressure of a GEM—on the order of one-half pound per square inch—makes it able to tread through a minefield without setting off pressure mines, which generally require about one pound per square inch for detonation. Wright is working on development of a mine-detecting GEM in two forms: one where the mine-search head is a GEM, boom-mounted on a parent craft, and one where the whole head and associated equipment is a remote-controlled GEM.

Port of New York Authority has shown interest in another Wright idea which features the GEM as a rescue vehicle for airports surrounded by water, swamps or mixed terrain. La Guardia and New York International Airports are such examples, with environs of shallow water filled with a marine growth which seriously hampers operation of conventional boats. GEMs could reach an aircraft downed off the end of a runway in an extremely short time and could perform a rescue mission that no other vehicle could.

But many problems remain to be solved in stability and control, in determining structural criteria, in noise reduction—Curtiss-Wright's first vehicle had a cockpit noise level of 120 db., enough to deafen permanently a human—and in the low friction of contact, which makes driving one of these vehicles like handling a car with bald tires on wet ice.

There is also a large segment of engineers who feel that these GEMs must be driven eventually by truck drivers, not by skilled engineering pilots, and the design of control systems for this concept is a difficult one.

The GEM is not a universal vehicle, but it does have a place. Right now that place is a specialized one, and only the pace of development over the next few years will provide enough information on costs to determine whether the GEM will be able to compete economically with existing types of ground and air transport.

First detail design characteristics of the Curtiss-Wright Model 200 and 300 VTOL transports were presented by H. V. Borst and J. M. Mergen of C-W's Propeller Division in another technical session (AW June 20, p. 277).

The Model 200, a six-place high-speed design powered by a pair of Lycoming T55 or General Electric T64 turboshaft engines, has four tilt-propellers mounted at the tips to tandem stub wings.

Each nacelle and propeller rotates through about 90 deg. for conversion from VTOL operation to the cruise phase. In the VTOL mode, differential propeller thrust is used for dynamic control about the three axes. During transition a combination of differential thrust and aerodynamic surface controls is used, and for cruise flight all control is aerodynamic.

At its normal gross weight of 12,300 lb., the airplane can hover on a sea-level standard day with one engine out, and can continue level flight with one engine out at any point in its flight envelope. Engines are inter-shafted so that either engine can drive all four propellers.

Over-all length of the six-place Model 200 is 43.4 ft., height is 16 ft. and span across the rotor tips is 34.5 ft.

Model 200 is about 95% complete in detail design, and about 50% complete in construction.

Although the Model 200 is geared to a proposed military application, but not a specific requirement, the Model 300 is aimed at the short-haul transport market. Using the same configuration with four tilt-propellers, C-W engineers have designed a four-engine, 44,000-lb. aircraft intended to carry 48

Photo courtesy Radio Corporation of America

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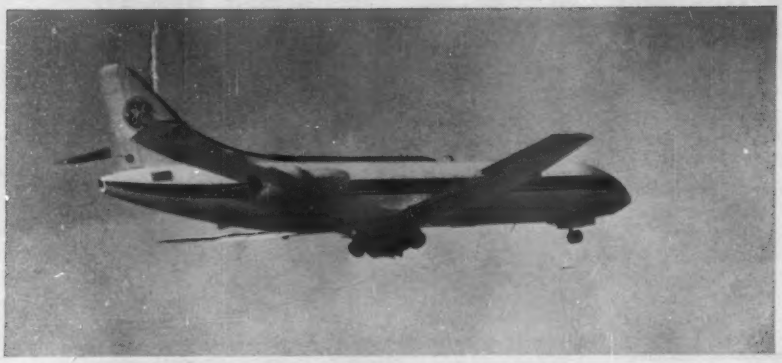


General Electric's Caravelle, equipped with CJ-805-23C aft-fan engines, completed its maiden flight Dec. 29. Production models are expected to be available in 1962.

G-E Caravelle Logs First Aft-fan Flight

EDWARDS AFB, Calif.—Fan-powered short/medium range jet airliners became a reality here Dec. 29 as General Electric's CJ-805-23C powered Caravelle completed its first flight.

The modified Caravelle III maintained an altitude of around 20,000 feet on its maiden flight of 1 hour and 25 minutes. Test pilot Dick Scoles reported that "the additional 40% take-off thrust of these fan engines was very noticeable. It shortened our take-off roll substantially and improved our acceleration and climb gradient. We also had the feeling that we had plenty of reserve power at cruising speeds."

Scoles added that he yawed the aircraft up to 10°, with no noticeable effect on fan speed.

General Electric took delivery of the aircraft from Sud Aviation last summer to demonstrate the performance of an aft-turbofan powered short/medium range jet airliner. Since October, the Caravelle's original turbojets and nacelles have been replaced with CJ-805-23C aft-fan engines and distinctive short-cowl nacelles, fabricated by Douglas Aircraft.

Aft-fan powered Caravelles are expected to be available for airline service in 1962. The production version of the CJ-805-23C powered aircraft will be called the Caravelle VII. Douglas will sell and service the Caravelle VII in the U.S. and in most other parts of the world.

For more details on the Caravelle VII, check GED-4176. See coupon.

NEA, TWA Begin Convair 880 Service

EVENDALE, O.—The G-E CJ-805-powered Convair 880 recently entered service with two more major commercial carriers as Northeast Airlines and Trans World Airlines introduced "the world's fastest jetliner" to their routes.

Northeast Airlines' first 880 set an unofficial "corner to corner" U.S. speed record during delivery Nov. 30, 1960. It flew from San Diego to Boston in 4 hours, 17 minutes. Earlier, a Delta 880 had set a speed record of 3 hours, 31 minutes from San Diego to Miami.

TWA began passenger service with the 880 Jan. 12, on routes between New York, Chicago, Las Vegas, Los Angeles, and Phoenix. Delivery of the balance of 24 airplanes will place the 880 on TWA routes throughout the U.S. NEA inaugurated 880 service on its Boston-Philadelphia-Miami run Dec. 15.

Powered by four CJ-805-3 engines, the 880 develops more than 44,000 pounds thrust. Engines are equipped with a clam-shell thrust reverser and ejector sound suppressor. Four G-E hydraulic constant speed drives operate in parallel to power the aircraft's 160-kva electrical system.

For more Convair 880/CJ-805-3 information, check GED-4192. For constant speed drive data, check GEA-6890. See coupon.

CJ-805-3 powered Convair 880 averaged 638 mph on 2,730-mile delivery flight to Northeast Airlines.

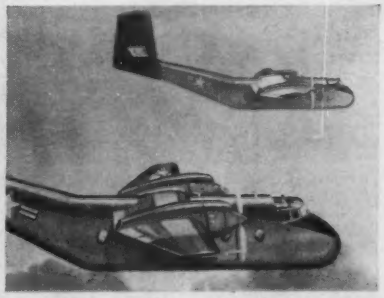
T64/de Havilland Caribou Flight Tests Set for May

LYNN, Mass.—A nine-month flight test program with General Electric T64 turboprop engines has been announced for the de Havilland DHC-4 Caribou STOL transport. The tests, slated to begin in May, will continue throughout 1961.

During the program more than 240 hours will be accumulated on two test engines. 20 hours of ground check-out and 100 hours of preliminary flight time are to be accomplished in first-phase testing. 300 hours of in-flight testing on each engine are scheduled to follow the initial test phase.

G.E.'s Small Aircraft Engine Department is responsible for installation and test engineering throughout the test period. Prior to flight test, inlet and prop tests are to be conducted at Lynn. The engine will log 7,000 hours of indoor testing before its maiden flight.

The T64 is available in four configurations—two turboprop, a turboshaft, and a direct drive—for fixed-wing utility VTOL and STOL aircraft.



Twin T64s will power the Caribou STOL utility transport in a Navy-sponsored flight test program.

The T64 is one of the first gas turbines to match the low fuel consumption of reciprocating engines. At military power the turboprop version develops 2,700 horsepower and has a specific fuel consumption (SFC) rating of 0.495.

For additional details on the T64, check GED-4094. See coupon.

NEWS

A report about progress in research and products from the Flight Propulsion Division of the General Electric Company

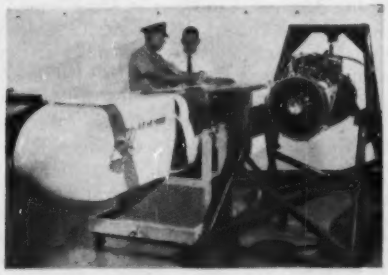
J85-powered GAM-72A Missile Completes Category I Tests

LYNN, Mass.—The GAM-72A "Green Quail," a decoy missile powered by General Electric's J85-7 turbojet engine, has completed Strategic Air Command Category I testing.

All flight tests with the G-E engine were successful. The 650-mph diversionary missile, designed and produced by McDonnell Aircraft Company, has been undergoing development and flight tests since 1959.

"Green Quail's" J85-7 turbojet powerplant develops 2,450 pounds thrust. Dropped in coveys by a B-52G mother ship, the missile is designed to confuse enemy air defenses by simulating the B-52 on enemy radar screens.

For more information on J85 turbojet engines, check GED-4095. See coupon.



The GAM-72A "Green Quail" decoy missile has completed SAC Category I testing. At the right is General Electric's J85-7 turbojet engine, which powers the 650-mph missile.

General Electric Offers Aft-fan Engine for Cargo Transport Aircraft

EVENDALE, O.—A new aft-fan engine, the 23,000-pound-thrust-class MF239-C-3, has been offered by General Electric to meet modern air cargo transport requirements.

Developed from G.E.'s proven CJ-805-23 aft-fan commercial engine, the MF239C-3 couples an advanced gas generator and a new "high power extraction" fan.

The MF239C-3 fan design incorporates a two-stage turbine/single-stage fan, aerodynamically coupled to the gas-generator compressor. The new fan provides a significant advance in turbofan development. It is expected to improve performance over earlier turbofans as they improved straight turbojet performance. Fan bypass ratio of 2.0 is optimum for a long-range, subsonic aircraft.

The coplanar exhaust, characteristic of aft-fan design, permits use of a quick-acting, clamshell thrust reverser to enhance short-runway performance. The reverser may also be used to modulate thrust in flight.

Present schedules call for production engines in mid-1963 with flight test engines available earlier.

For additional information on the MF239C, check GED-4260. See coupon.

North American A3J Claims World Altitude Lift Record

Decorated for their 17-mile ascent were Commander Leroy A. Heath, pilot, and Lt. Larry Monroe, navigator, of the record-breaking Vigilante. Commander Heath received the Distinguished Flying Cross, Lt. Monroe the Air Medal.

EDWARDS AFB, Calif.—The Navy's North American Aviation A3J Vigilante, powered by two General Electric J79 engines, on Dec. 13 filed a claim on the world altitude record for a land-based jet aircraft carrying a 1,000-kilogram (2,204.6 pounds) payload.

The claim, for an altitude of 91,450.8 feet, is now pending before the Federation Aeronautique Internationale (FAI). The Mach 2 Vigilante soared 24,354 feet over the previous record of 67,096 feet set in 1959 by a Russian twin-jet RV monoplane.

The A3J, first U.S. participant in this altitude test, has two J79 powerplants, providing more than 32,000 pounds of thrust. The engines weigh less than 3600 pounds each, to provide the highest thrust-to-weight ratio in their class.

To meet FAI requirements in this event, aircraft must carry 1,000 kilograms in a compartment measuring at least 141 cubic feet. On the record flight the A3J's payload was carried in the plane's tunnel-like linear bomb bay.

The J79-powered Vigilante, fastest attack aircraft in Navy history, is now undergoing flight tests prior to fleet assignment. Built for carrier operation, the all-weather A3J can deliver both nuclear and conventional weapons at twice the speed of sound.

FOR MORE DETAILED INFORMATION on these and other developments in General Electric products, contact your nearest G.E. Flight Propulsion Division representative or indicate below the free brochures you would like to receive.

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- ☐ GED-4095 "J85"
- ☐ GED-4176 "Caravelle"
- ☐ GED-4192 "880/CJ-805-3"
- ☐ GED-4260 "MF239C"

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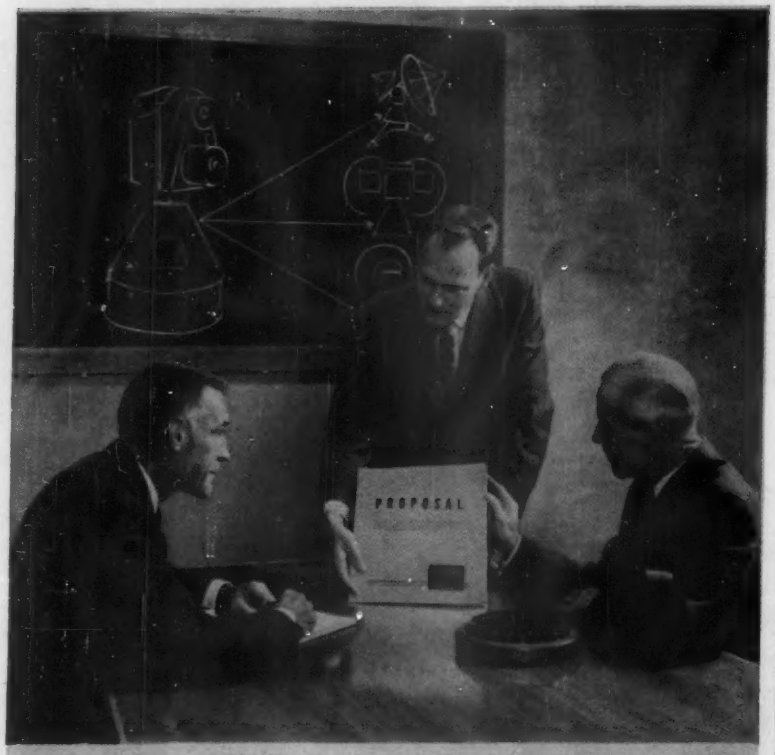

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passengers at a cruise speed of 300 kt. at altitudes of 10,000 ft. Costs calculated by the Air Transport Assn. method are as low as 2.4 cents per available seat-stat. mi. for a 400 mi. stage length, increasing to about five cents for 100-mi. stage lengths, based on 2,000-hr. utilization per year.

Powerplant

Powerplants for the proposed Model 300 are four General Electric T64 turboshaft engines, again intershafted for engine-out operations. Control system is the same as that specified for the Model 200.

Over-all length is 72 ft., width is 64 ft., and height is 24 ft.

Noise level is claimed to be low due to the low tip speed and loading of the propellers. Studies made by the company indicate that noise level at 200 ft. from the machine is about 80 db., less than normal for a city street. At 3,000 ft. the noise level is about the same as that of a residential area.

New details of Vertol developments in compounded or advanced helicopters were presented by L. L. Douglas, of Boeing Airplane Co.'s Vertol Division.

Douglas said the Vertol Model 107-VI now under development will have a cruise speed of 175 kt. General clean-up accounts for much of this gain, with retractable landing gear, rotor hub fairings and extended fuselage aft section helping to reduce the drag, and large chord blades improving the lifting rotor system. The resulting increase in lift-drag ratio will produce the speed increase.

Two General Electric T58 engines, each rated at 1,400 shp., will power the 107 VI. Its gross weight will be 19,130 lb.

Compounding the Chinook, now under development for the Army, is one way to increase cruise speeds. By putting a pair of tandem stub wings on the basic Chinook design, the gross weight goes up to 33,800 lb. from the current Chinook value of 32,000. But the cruise speed also climbs from an estimated 160 kt. to 227 kt. and direct operating costs are calculated to decrease from 5.5 cents per seat mile to 4.9 cents.

VTOL Transport

Douglas also presented comparative figures for a four-engined tilt-wing VTOL transport, designed to carry 66 passengers at a cruise speed of 325 kt. Powered by four T64 turboshaft engines rated at 2,650 shp. each, the VTOL transport would weight approximately 45,000 lb.

Calculations for the aircraft show direct operating costs of 3.5 cents per seat mile, almost as low as the 3.3 figure of the Fairchild F-27 which Douglas used as a comparison. ◆◆

PRODUCTION BRIEFING

Sylvania Electric Products, Inc., Buffalo, N. Y., will continue production of the electronic defense system for the Convair B-58 bomber under $9-million contract. The electronic defense system consists of a radar warning subsystem, a chaff dispenser control and a radar track breaker.

Vinco Corp., Detroit, Mich., will enter the beryllium components field. Initial market for the beryllium components will be the field of nuclear energy; however, the company expects to produce components for missile and space vehicle applications.

Chrysler Corp. will supply component modification and related engineering on the Jupiter intermediate range ballistic missile under $1.3-million Army contract. To date, the Army Ordnance Missile Command has awarded Chrysler Jupiter contracts totaling $296 million.

The Hayes Corp., Birmingham, Ala., will maintain aircraft assigned to the Army Aviation School, Fort Rucker, under $5-million contract. The contract was awarded to Hayes by Headquarters, Third U. S. Army.

Northrop Corp.'s Radioplane Division, Van Nuys, Calif., will produce 770 RP76-3 target missiles for the Army under $2.9 million contract. The air-launched, solid-propellant missile will be used in training Nike Ajax and Nike Hercules air defense missile crews.

Tool Research and Engineering Corp., Beverly Hills, Calif., will provide tooling for the YB-70 bomber under $2.5 million contract from North American. The jig and fixture and special tooling for sections and subassemblies of the B-70 will be produced at the company's Compton, Calif., facility.

Wyman-Gordon Co., Worcester, Mass., will expand its beryllium forging capabilities under a $3-million company-financed program. Included in the expansion is the transfer of precision forging equipment from the company's Franklin Park, Ill., plant to North Grafton, Mass. This is intended to increase the Massachusetts plant's capability in forging small beryllium components.

Cessna Aircraft Co.'s Industrial Products Division will establish a hydraulic equipment assembly plant in Glenrothes, Fife, Scotland. Scheduled to begin operations this spring, the Scottish facility will assemble Cessna's agricultural and earth-moving hydraulic equipment for sale in the United Kingdom.

Additional funding in the amount of $4,941,537 under a U. S. Navy contract has been received by Lockheed Aircraft Corp.'s California Division for electronic re-equipment of P2V-5 and P2V-7 aircraft. The total contract is in the amount of $36 million and involves 300 of the antisubmarine warfare Neptunes already in Navy service. The new electronic equipment permits submarine detection at greater range than with previous gear.

Slick Airways has awarded a $1.5-million contract to Pacific Airmotive Corp. for overhaul of Rolls-Royce Tyne engines on the Canadair CL-44s which the airline will take delivery on in September. First Tyne engines under the Slick contract are expected to arrive at PAC before the end of 1961 with cycle time averaging 21 days.

Bowmar Instrument Corp., Fort Wayne, Ind., has received a $23,000 order from Ford Instrument Division of Sperry Rand Co. for special three-drum angle counters to provide digital read-out on airborne navigational units.

General Electric's Missile and Space Vehicle Department has been awarded a $200,000 contract for research and development in the field of high-temperature materials for space power. The NASA contract calls for means to store heat energy collected from the sun so that electrical power can be produced in satellites while they pass through the earth's shadow. Work will include investigation of materials that can store heat and also materials that can contain the heat-storing materials.

Garrett Corp.'s AiResearch Manufacturing Division, Phoenix, Ariz., will produce dual pneumatic engine starters for the Republic F-105 under terms of a $1-million contract from the Air Force Materiel Command.

Gulton Industries, Inc., will supply analog to digital converter systems to the Army for use in the Sergeant missile program under terms of a $435,000-contract. The analog to digital converters will be used for measuring missile guidance and flight stability.

Aeronutronic Division of Ford Motor Co. will investigate semi-rigid and non-rigid space structures for use at extreme altitudes under a $140,000 contract from Wright Air Development Div. Contract results from two previous programs conducted by Aeronutronic's space systems operation, one of which provided guidelines to the Air Force for using rigid structures in space.

ENGINEERING REPORT ON OTHER BENDIX COMPONENT PACKAGES

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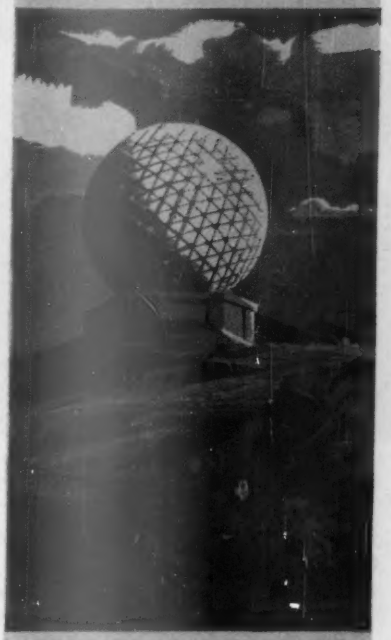

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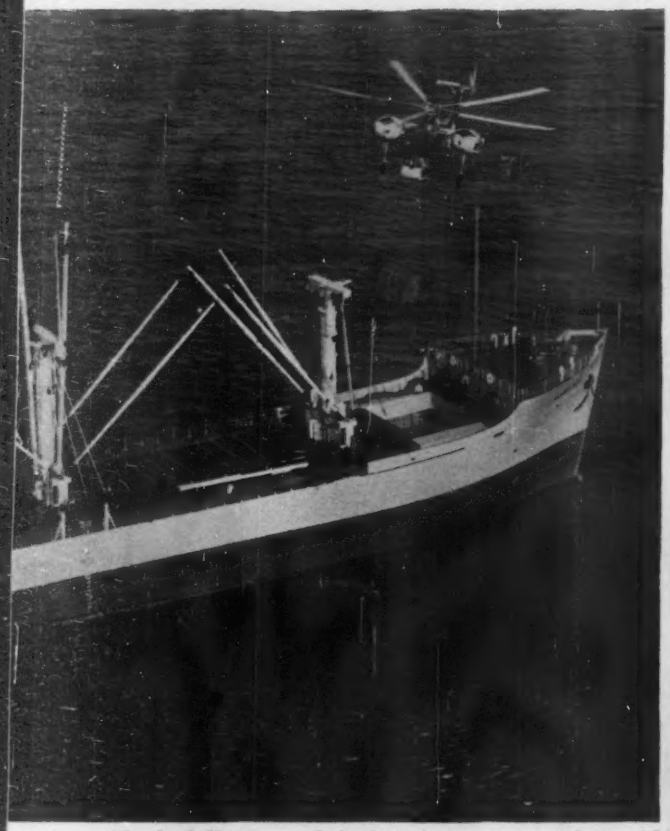

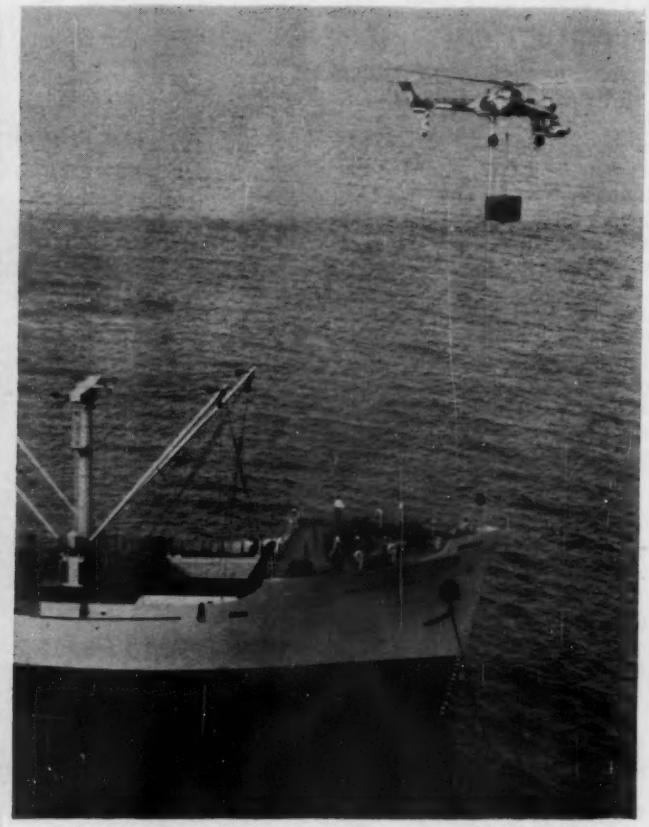

Sikorsky S-60 Skycrane hoisted an Army cargo container weighing 3,800 lb. from the hold of the U. S. Army cargo vessel Hickory Knoll during a demonstration by U. S. Army Transportation Corps at Ft. Story, Va. Pickup was made with a winch, cargo hook and 100 ft. of steel cable as the Skycrane hovered directly over the forward hold. Similar demonstration also was made in the New York harbor.

S-60 Skycrane Lifts Container From Ship's Hold

About two minutes after lifting the container from the forward hold of the Hickory Knoll, the two-ton package was lowered to the bed of a truck on the beach. Work party at lower left is handling lines to steady the container as it settles onto the truck bed. Hickory Knoll is at left background. Powerplants for the Skycrane are Pratt & Whitney R-2800s.

Kennedy Group Criticizes Space Effort

A special task force headed by the new White House science adviser, Dr. Jerome B. Wiesner, has made a study of U.S. space and missile efforts for President John F. Kennedy. Because it is expected to become a blueprint for the new administration's revisions of both programs (AW Jan. 16, p. 26), AVIATION WEEK is printing the entire report and its recommendations.

Activities in space now comprise six major categories:

- Ballistic missiles.
- Scientific observations from satellites.
- The exploration of the solar system with instruments carried in deep space probes.
- Military space systems (Separate Classified Report).
- Man in orbit and in space.
- Non-military applications of space technology.

We rely on the first member of the list, ballistic missiles, for a large part of the retaliatory response to the Russian missile threat.

It is generally assumed by the American citizen that our vast expenditures of money and technical talent in the national space program are primarily designed to meet the overriding needs of our military security. The fact is, however, that the sense of excitement and creativity has moved away from the missile field to the other components of the list, and that missiles, long before they are in condition for us to depend upon them, are slowly being relegated to the category of routine management.

Before we proceed in this report to discuss and support the important activities in the other five categories, we wish to emphasize the hazard of failing to complete and deploy on time our intercontinental deterrent missiles.

In addition to the need to develop ballistic missiles to provide for our military security, there are five principal motivations for desiring a vital, effective space program. It is important to distinguish among them when attempting to evaluate our national space effort.

National Prestige Factor

First, there is the factor of national prestige. Space exploration and exploits have captured the imagination of the peoples of the world. During the next few years, the prestige of the United States will in part be determined by the leadership we demonstrate in space activities. It is within this context that we must consider man in space. Given time, a desire, considerable innovation, and sufficient effort and money, man can eventually explore our solar system. Given his enormous curiosity about the universe in which he lives and his compelling urge to go where no one has ever been before, this will be done.

Second, we believe that some space developments, in addition to missiles, can contribute much to our national security —both in terms of military systems and of arms-limitation inspection and control systems.

Third, the development of space vehicles affords new opportunities for scientific observation and experiment—adding to our knowledge and understanding of the earth, the solar system, and the universe. In the three years since serious space exploration was initiated, the United States has been the outstanding contributor to space science. We should make every effort to continue and to improve this position.

Fourth, there are a number of important practical non-military applications of space technology—among them satellite communications and broadcasting, satellite navigation and geodesy, meteorological reconnaissance, and satellite mapping—which can make important contributions to our civilian efforts and to our economy.

International Cooperation

Finally, space activities, particularly in the fields of communications and in the exploration of our solar system, offer exciting possibilities for international cooperation with all the nations of the world. The very ambitious and long-range space projects would prosper if they could be carried out in an atmosphere of cooperation as projects of all mankind instead of in the present atmosphere of national competition.

The ad hoc panel has made a hasty review of the national space program, keeping in mind the objective—to provide a survey of the program and to identify personnel, technical, or administrative problems which require the prompt attention of the Kennedy Administration. We have identified a number of major problems in each of these categories, and they will be discussed in this report. It is obvious that there has been inadequate time to examine all facets of the program or to permit full consideration of the possible answers to many of the questions raised.

DR. JEROME B. WIESNER

Because of the overriding necessity to provide more efficient and effective leadership for the program, the group has devoted a major portion of its time to this aspect of the space program. We will, however, indicate important scientific and technical problems which should be thoroughly examined as soon as possible.

National Objectives

We have concluded that it is important to re-assess thoroughly national objectives in the space effort—particularly in regard to man in space, space science and exploration, and the non-military applications of space, in order to assure a proper division of effort among these activities. Space activities are so unbelievably expensive and people working in this field are so imaginative that the space program could easily grow to cost many more billions of dollars per year.

While we are now compelled to criticize our space program and its management, we must first give adequate recognition to the dedication and talent which brought about very real progress in space during the last few years. Our scientific accomplishments to date are impressive, but unfortunately, against the background of Soviet accomplishments with large boosters, they have not been impressive enough.

Our review of the United States' space program has disclosed a number of organizational and management deficiencies as well as problems of staffing and direction which should receive prompt attention from the new administration. These include serious problems within NASA, within the military establishment, and at the executive and other policy-making levels of government. These matters are discussed in the sections which follow.

The nation's ballistic missile program is lagging. The development of the missiles and of the associated control systems, the base construction, and missile procurement must all be accelerated if we are to have the secure missile deterrent force soon that the country has been led to expect.

While additional funds will undoubtedly be required to accomplish this, we believe that re-establishing an effective, efficient, technically competent management for the program is the overriding necessity.

Missile Effort Vital

Though the missile program is not ordinarily regarded as part of the space program, it is important to recognize that for the near future the achievement of an adequate deterrent force is much more important for the nation's security than are most of the space objectives, and that at least part of the difficulty in the management and execution of the program stems from the distraction within the Defense Department and in industry caused by vast new space projects. However, we have no alternative but to press forward with space developments.

There is an urgent need to establish more effective management and coordination of

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Bulletin CEC 1631-X6.

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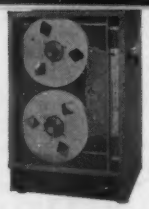
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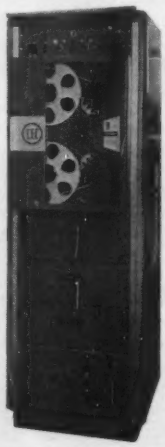
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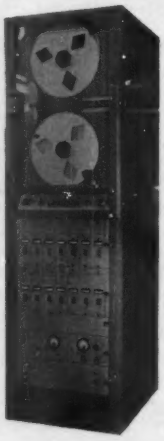
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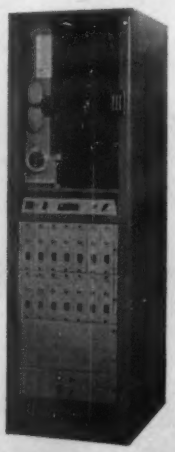
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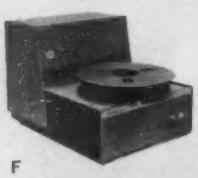
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the United States space effort. The new administration has promised to move our country into a position of pre-eminence in the broad range of military, cultural, scientific and civilian applications of satellite and other space vehicles.

This cannot be done without major improvements in the planning and direction of the program. Neither NASA as presently operated nor the fractionated military space program nor the long-dormant Space Council have been adequate to meet the challenge that the Soviet thrust into space has posed to our military security and to our position of leadership in the world.

In addition to the difficulties and delays which the program has endured because of the lack of sufficient planning and direction, it has also been handicapped because too few of the country's outstanding scientists and engineers have been deeply committed to the development and research programs in the space field. In changing the management structure and in selecting the administrators for the effort, the need to make space activities attractive to a larger group of competent scientists and engineers should be a guiding principle.

Stronger Space Council

The new administration has announced that it plans to use the National Aeronautics and Space Council for coordinating government space activities, for advising the President on policy, on plans and on the implementation of programs. We believe that the Space Council can fulfill this role only if it is technically well-informed and, moreover, seriously accepts the responsibility for directing the conduct of a coherent national space effort. Particular care should be taken to ensure the selection of a very competent and experienced staff to assist the council.

Not only must we provide more vigor, competence and integration in the space field, but we must also relate our space requirements to other vital programs which support our national policy. We refer particularly to the missile needs, already mentioned, and to the continuing need for development and research in the field of aeronautics.

Each of the military services has begun to create its own independent space program. This presents the problem of overlapping programs and duplication of the work of NASA. If the responsibility of all military space developments were to be assigned to one agency or military service within the Department of Defense, the Secretary of Defense would then be able to maintain control of the scope and direction of the program and the Space Council would have the responsibility for settling conflicts of interest between NASA and the Department of Defense.

We are also concerned by the NASA preoccupation with the development of an in-house research establishment. We feel that too large a fraction of the NASA program, particularly in the scientific fields, is being channeled into NASA-operated facilities.

One important responsibility of NASA given little attention now in the organization is that of providing for basic research and advanced development in the field of aeronautics. There is a general belief in the aviation industry that the national pre-

Task Force Members

Dr. Jerome B. Wiesner, director of the Research Laboratory of Electronics at Massachusetts Institute of Technology and new special assistant for science and technology to President Kennedy, served as chairman of the Ad Hoc Committee on Space which prepared the missile and space report for Kennedy. Members were:

- Kenneth E. BeLieu, staff director, Senate Committee on Aeronautical and Space Sciences.
- Trevor Gardner, president of Hycon Manufacturing Co.
- Donald F. Hornig, chairman of Princeton University's department of chemistry.
- Edwin H. Land, president of the Polaroid Corp.
- Max Lehrer, assistant staff director, Senate Committee on Aeronautical and Space Sciences.
- Edward M. Purcell, professor of physics, Harvard University.
- Bruno B. Rossi, professor of physics, Massachusetts Institute of Technology.
- Harry J. Watters, assistant to the president, Polaroid Corp.

occupation with space developments has all but halted any advance in the theory and technology of aerodynamic flight. There is ample evidence to support the contention that the Russians and possibly the British are surpassing us in this field and consequently in the development of supersonic commercial aircraft.

We should make a substantial effort to correct this situation, possibly by getting some of NASA's aeronautical and aerodynamic experts back into the field of advanced aircraft research and development. Possibly, after careful investigation, the Space Council would prefer to stimulate this work by non-governmental arrangements, or by placing it entirely in another agency.

We believe that the work of NASA would be facilitated and the task of recruiting staff made possible if an outstanding expert was placed in charge of the direction and management of each of the following important areas of work:

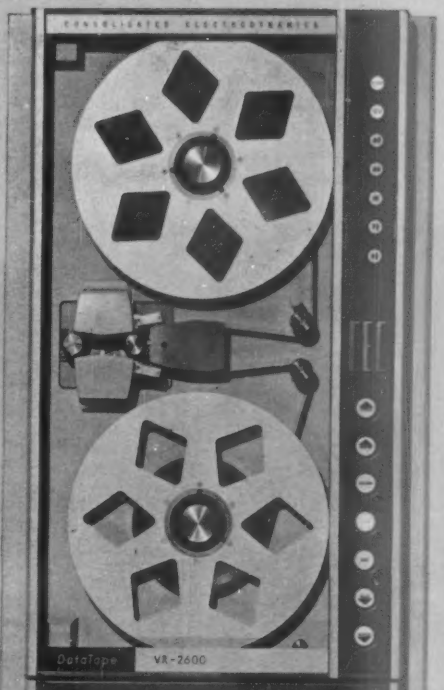
- **Propulsion and vehicle** design and development.
- **The space sciences.**
- **Non-military exploitation** of space technology.
- **Aeronautical sciences** and aircraft development.

The inability of our rockets to lift large payloads into space is the key to the serious limitations of our space program. It is the reason for the current Russian advantage in undertaking manned space flight and a variety of ambitious unmanned missions. As a consequence, the rapid development of boosters with a greater weight-lifting capacity is a matter of national urgency.

Payload weight is currently limited by our dependence on modified military rockets as the primary boosters (Thor, Jupiter, Atlas). Current plans call for the first substantial increase in payload with the addi-

Newest advance in tape recorders–

300 cps to 500,000 cps



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Keep up to date on CEC's advances in the tape recording field. For more information, write for Bulletin CEC 2600-X2. or call your nearest CEC sales and service office.

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A Step Ahead of the State of the Art in ***Communications***

How to lock on 28.000 frequencies—*blindfolded*

The Stromberg-Carlson S-C 901 single sideband transceiver speaks with all the authority and range of 100 watts, yet measures only 14" x 17" x 17" overall, weighs a trim 70 pounds. All in all, a compact, rugged, easy-to-operate and highly reliable unit.

Digital tuning gives you fast, precise selection of any one of 28,000 frequencies—from 2 to 30 megacycles—and locks on. Frequencies have a stability of one part in 10^7 per week. Highly transistorized, the unit draws less than half the power of comparable AM equipment; and where tubes are used, a unique heat-sink design eliminates forced air cooling.

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tion of the Centaur upper stage to the Atlas in 1962, followed by a second big step with the Saturn booster in 1965.

It is likely that a variety of new booster programs will be proposed in the near future, particularly for military projects. There are no fundamental differences in civilian and military requirements which are foreseeable now. If the national effort is to be focused and the very large expenditures are not to be distributed among an excessive number of booster programs, it is important that we maintain and strengthen the concept of a National Booster Program.

A number of problems may well arise in the National Booster Program. The present Mercury program, based on the Atlas, is marginal and if the Atlas proves inadequate for the job it may be necessary to push alternatives vigorously. The first possibility appears to be the Titan, although it has not yet demonstrated the reliability which is required. We should study the desirability of carrying out a Titan-boosted Mercury program in the event Atlas should prove to be inadequate.

The Centaur rocket involves an entirely new technology and is still untested. If difficulties develop in this program within the next three or four months, we must act promptly to initiate an alternate.

Single Solutions Dangerous

Development of the Saturn booster—a cluster of eight Atlas engines—should continue to be prosecuted vigorously. However, it would be dangerous to rely on Saturn alone for the solution to our problems, either in the long or short term, for two reasons:

- **It is intrinsically** so complex that there is a real question whether it can be made to function reliably.
- **It represents** a maximum elaboration of present technology and provides no route to further development.

Therefore, the development of a very large single engine should proceed as fast as possible so that it may be a back-up for the Saturn cluster and a base for future larger vehicle development. The present F-1 (1.5-million-lb. thrust) engine development should be studied to be sure it is progressing fast enough and has enough promise of success to fill this role. If the technological step in going from the present 180,000-lb. thrust engines to 1.5 million lb. is so big as to make success marginal, a parallel development of a somewhat smaller engine should be started.

The nuclear rocket program (Rover) presents an area in which some major decisions will have to be taken by the new administration

In principle, the nuclear rocket can eventually carry heavier payloads much farther than any chemical rocket. Nevertheless, the technology is so new and the extrapolation from reactors developed now to sizes which would be useful in large rockets is so great that it is not clear how soon they will make an important contribution to the space program.

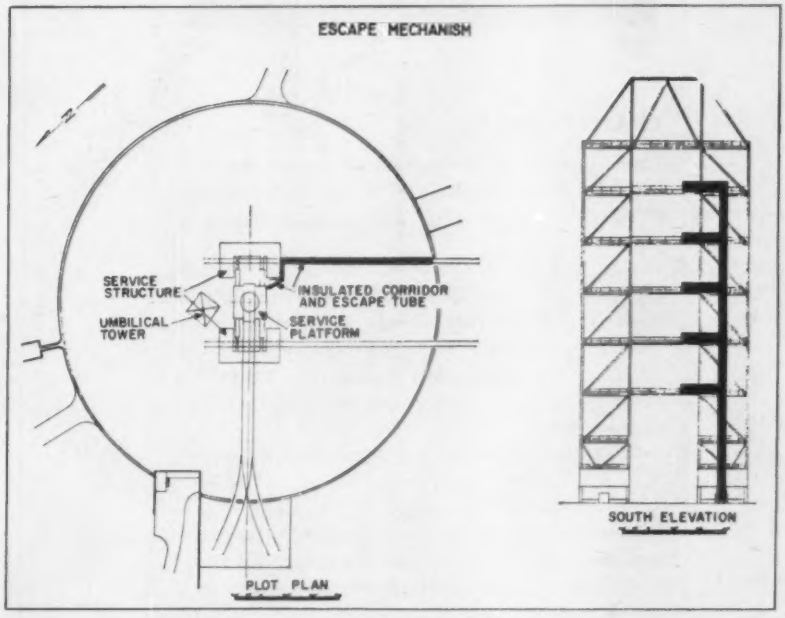
The use of nuclear rockets will raise serious international political problems since the possibility that a reactor could reenter and fall on foreign territory cannot be ignored. A major technical and management review of the Rover program seems urgent.

Above all, we must encourage entirely new ideas which might lead to real breakthroughs. One such idea is the Orion proposal to utilize a large number of small nuclear bombs for rocket propulsion. This proposal should receive careful study with a realization of the international problems associated with such a venture.

In the three years since space exploration began, experiments with satellites and deep space probes have provided a wealth of new scientific results of great significance. In spite of the limitations in our capability of lifting heavy payloads, we now hold a position of leadership in space science.

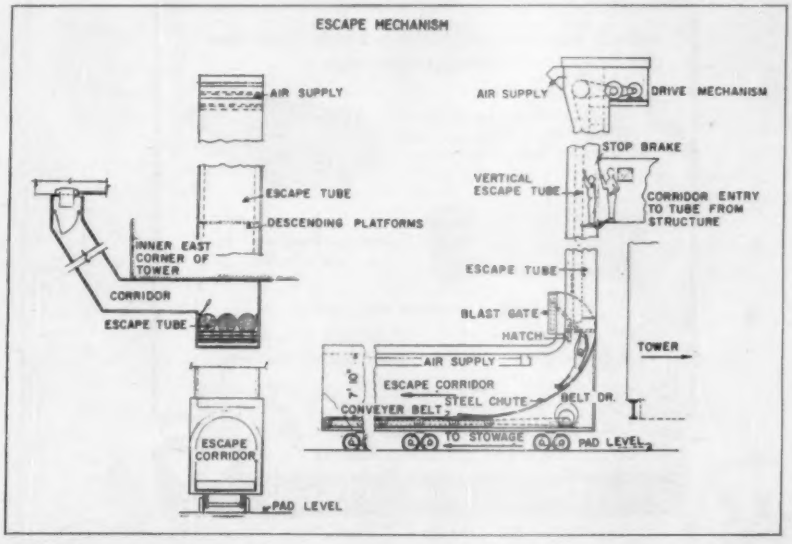
American scientists have discovered the great belt of radiation trapped within the earth's magnetic field. American scientists have revealed the existence of a system of electric currents that circle our planet. Our space vehicles have probed the interplanetary space to distances of tens of millions of miles from the earth. They have shown that the earth is not moving through an empty space but through an exceedingly thin magnetized plasma. They have intercepted streams of fast-moving plasma ejected from the sun which, upon reaching our planet, produce magnetic storms, trigger off auroral displays and disrupt radio communications.

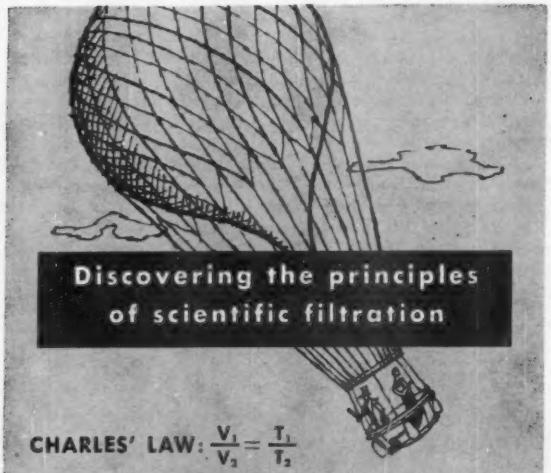
From these and other experiments, there is gradually emerging an entirely novel picture of the conditions of space around



Saturn Tower Escape System

Bidders briefing for construction of this escape chute for the 310-ft. Saturn launch tower at the Atlantic Missile Range was scheduled to be held Jan. 19 at the Jacksonville District Office, Corps of Army Engineers. System, expected to cost $400,000, includes escape capsules, conveyor belt, water brake, and escape corridor. Bids will be opened Feb. 7, with completion deadline scheduled for Jan. 3, 1962.





Discovering the principles of scientific filtration

CHARLES' LAW: $\frac{V_1}{V_2} = \frac{T_1}{T_2}$

"Gases under constant pressure expand in equal proportion from the same temperature for equal temperature increments."

Jacques Charles (1746-1823)

Through his interest in ballooning, French physicist Jacques Charles, in 1787, determined that the pressure coefficients of expansion of all gases are the same. Further study by Guy-Lussac in 1802 revealed that all gases have the same volume coefficient of expansion; later Regnault observed that the increase in volume per degree centigrade was 1/273 of the original volume.

Similarly at Air-Maze, constant research and testing establishes new principles to improve filtration. For 35 years Air-Maze engineers have worked together pioneering new industrial filtration products based on the findings of Charles and others. The result is a complete line of specialized industrial filtration products for every situation involving the movement of gases and liquids.

Shown below are representative products developed by Air-Maze engineers to keep equipment clean and free from damaging contaminants for longer, better operation.

Liquid or Air Filters—from missiles to private aircraft there is an Air-Maze filter to meet your requirements.

In-line Filters—small, lightweight. These filters are used in missile hydrazine fuel systems.

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our planet and of the sun-earth relations. One of the important tasks of space science in the next few years will be a full exploration of the new field revealed by the early experiments. There is little doubt that such exploration will lead to further important discoveries.

Advances in Astronomy

Another scientific field where space science promises an early and major breakthrough is that of astronomy. Until a few years ago, visible light from celestial objects, reaching our telescopes through the atmospheric blanket, had been the only source of astronomical information available to man. The only other portion of the spectrum capable of penetrating the atmosphere and the ionosphere is that corresponding to short-wave radio signals.

In recent years, the development of radio telescopes has made it possible to detect these signals. Radio astronomy has enormously advanced our knowledge of the universe. By means of radio telescopes we can now "see" not only the stars, but also the great masses of gas between the stars; we can detect the high-energy electrons produced by cosmic accelerators located thousands of millions of light years away from the earth.

We are entitled to expect a similar and even perhaps a more spectacular advance the day that we shall have telescopes installed aboard satellites circling the earth above the atmosphere and the ionosphere. These instruments will be capable of detecting the electromagnetic spectrum—from long-wave radio signals to gamma-rays.

A third major task of space science in the years to come will be the exploration of the moon and the planets. Scientists are planning to fly instruments to the vicinity of these celestial objects, and eventually to land them upon their surface. From the data supplied by these instruments they expect to obtain information of decisive importance concerning the origin and the evolution of the solar system. Moreover, there is the distinct possibility that planetary exploration may lead to the discovery of extra-terrestrial forms of life. This clearly would be one of the greatest human achievements of all times.

Scientific Talent

Our present leadership in space science is due to a large extent to the early participation of some of our ablest scientists in our space program—primarily as part of the International Geophysical Year—and to the fact that these scientists were in a position to influence this program. Another important factor was our initial advantage in instrumentation, which helped to offset our disadvantage in propulsion.

We must not delude ourselves into thinking that it will be easy for the U. S. A. to maintain in the future a prominent position in space science. The USSR has a number of competent scientists. It will be easier for them to catch up with us in instrument development than for our engineers to catch up with the Russians in the technique of propulsion. Thus we must push forward in space science as effectively and as forcefully as we can.

Our scientific program in space appears to be basically sound. However, to ensure

Tracking Every "Bird" in a Flock

Keeping track of a sky full of "birds,"—whether friendly or enemy—poses one of the most complex problems in modern radar electronics.

Control centers must know where each aircraft is at all times, whatever the weather. This means its direction, its distance, and its altitude in relation to all other "birds" in the sky. And they must know instantly, for seconds are miles at modern speeds.

In cooperation with the Air Force, Westinghouse Electronics Division at Baltimore has developed a new 3-Dimension radar that can accomplish this difficult task—the versatile AN/FPS-27.

One radar supplies both search and height data simultaneously. In an automatic system, it can supply real time digital data on an unlimited number of targets.

The AN/FPS-27 and other 3-D radars such as AN/TPS-27 and AN/SPG-59, plus high-discrimination radar techniques such as Phalanx and Synthetic Spectrum, are examples of how the Baltimore divisions of Westinghouse are applying electronic science for Defense. *You can be sure . . . if it's*

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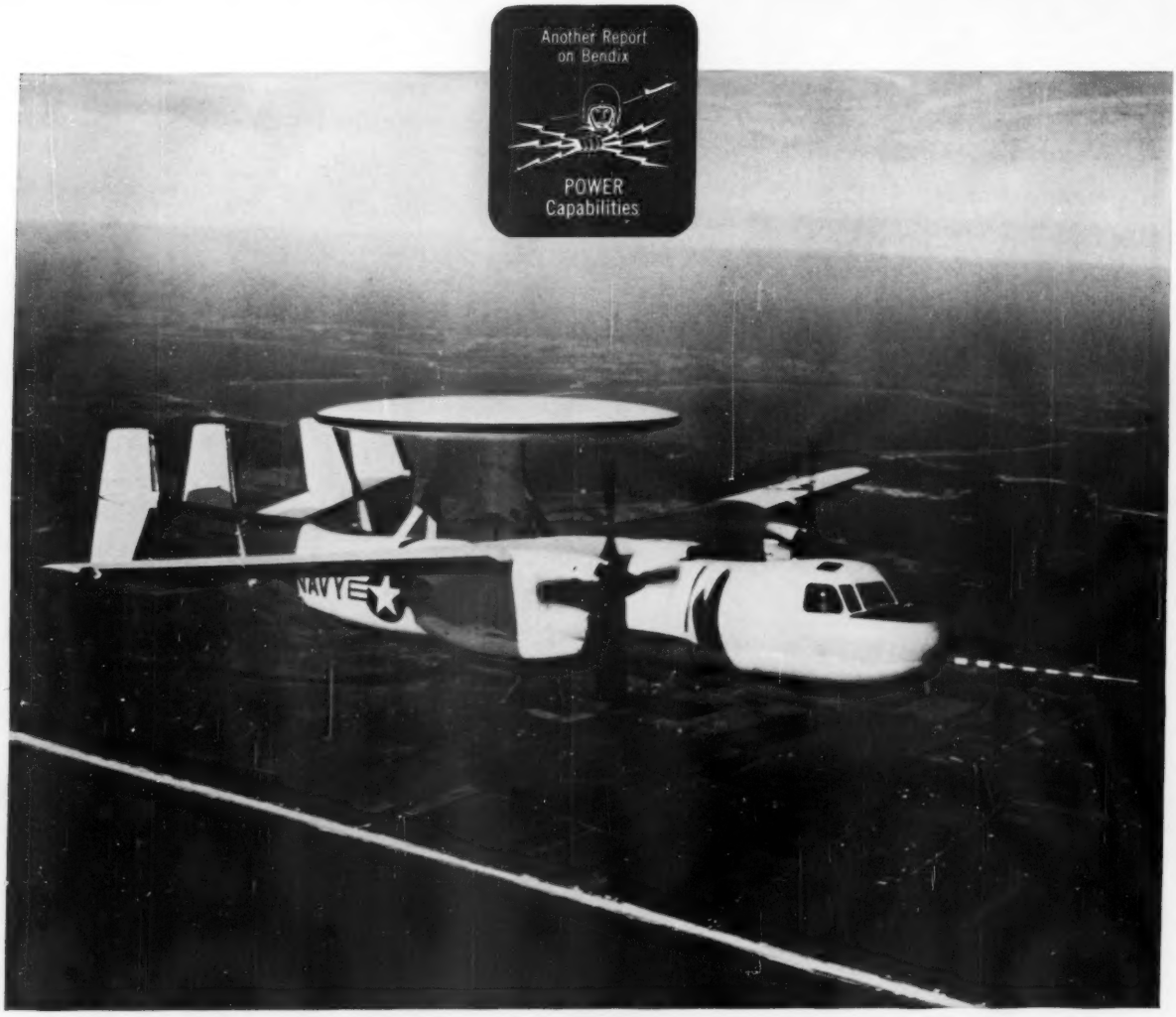
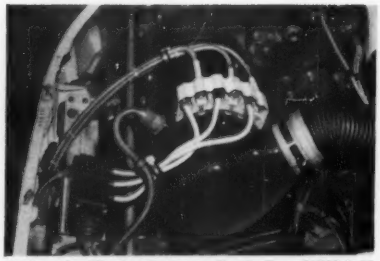


BENDIX AC BRUSHLESS GENERATING SYSTEMS SPECIFIED FOR NAVY'S "HAWKEYE"

Long Range Radar Detection and Control of Intercepts—with minimum reaction time. That's the U. S. Navy's mission for Grumman's W2F-1 "Hawkeye." With a crew of five, the W2F-1 will be one of the largest carrier-based aircraft, performing airborne-early-warning missions.

Heart of the W2F-1 avionic-electrical system: two Bendix® AC Brushless Generating Systems designed to meet the latest Military Standard (MS) requirements. Together with companion Bendix solid-state regulation and protection components, these brushless systems supply the reliable, efficient electrical power that's so essential to the "Hawkeye's" mission.

Bendix builds a complete line of AC Brushless Generating Systems rated from 10 KVA to 75 KVA—all available with solid-state regulating and control-protective equipment. Ask for details on a system to meet your airborne or ground needs.



Used on the "Hawkeye" are two Bendix Type 28B95-3/60 KVA AC Brushless Generating Systems such as this. They're direct-driven by the aircraft's two turboprop engines.

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its success, the following requirements must be met:

• **In the planning** of our space activities, scientific objectives must be assigned a prominent place.

• **Our space agency** must ensure a wide participation in its program by scientists from universities and industrial laboratories, where our greatest scientific strength lies.

• **It must provide** adequate financial support for the development and construction of scientific payloads.

• **It must exert** the greatest wisdom and foresight in the selection of the scientific missions and of the scientists assigned to carry them out.

• **It must initiate** immediately a research program in advanced instrumentation, so that we may be ready to exploit fully the capability of flying heavier and more complex payloads that we shall possess several years from now. Problems of automation, processing and transmission of information must be tackled by competent and imaginative research teams.

Man in Space

We are rapidly approaching the time when the state of technology will make it possible for man to go out into space. It is sure that, as soon as this possibility exists, man will be compelled to make use of it, by the same motives that have compelled him to travel to the poles and to climb the highest mountains of the earth. There are also dimly perceived military and scientific missions in space which may prove to be very important.

Thus, manned exploration of space will certainly come to pass and we believe that the United States must play a vigorous role in this venture. However, in order to achieve an effective and sound program in this field, a number of facts must be clearly understood.

• **Because of our lag** in the development of large boosters, it is very unlikely that we shall be first in placing a man into orbit around the earth.

• **While the successful** orbiting of a man about the earth is not an end unto itself, it will provide a necessary stepping stone toward the establishment of a space station and for the eventual manned exploration of the moon and the planets. The ultimate goal of this kind of endeavor would, of course, be an actual landing of man on the moon or a planet, followed by his return to the earth. It is not possible to accomplish such a mission with any vehicles that are presently under development.

• **The acquisition** of new knowledge and the enrichment of human life through technological advances are solid, durable, and worthwhile goals of space activities. There is general lack of appreciation of this truism, both at home and abroad.

Indeed, by having placed highest national priority on the Mercury program we have strengthened the popular belief that man-in-space is the most important aim of our non-military space effort. The manner in which this program has been publicized in our press has further crystallized such belief. It exaggerates the value of that aspect of space activity where we are less likely to achieve success, and discounts those aspects in which we have already achieved great success and will probably reap further successes in the future.

As the technical feasibility and reliability of man-made satellites was demonstrated, many possible civilian uses for satellites emerged. With no government support, various groups in private industry have examined the field for areas of study and development and a few substantial projects are already under way.

Industrial and governmental communication satellites appear practical and economically sound. Communication satellites will provide high quality and inexpensive telephone and general communication service between most parts of the earth. A by-product of a communication satellite will almost surely be an international television relay system linking all the nations of the world.

On a longer time scale, it should be feasible to provide radio and television broadcasting service via satellite-mounted transmitters. Such systems would give the quality broadcast reception now only available in and near urban areas to most of the inhabitants of the earth.

Satellites containing reliable beacons can be used to provide improved means of navigation for aircraft and ships at sea and can greatly advance the field of geodetics.

Proper use of the information gathered by meteorological satellites should greatly increase our understanding of meteorology. With more knowledge of meteorology and with world-wide data frequently available from the satellites, longer-range and more reliable weather predictions should be possible. These projects, dreams a decade ago, bridge areas of technical specialty in which this nation is unexcelled.

U. S. Pre-eminence

The United States has the most advanced communication system in the world, with a vast scientific and technological base supporting the communication industry. We are pre-eminent in the development of our electronic skills in radio, television, telephone and telegraphy. This entire industrial-scientific base is available to apply its art through satellite systems to the civilian needs of the world.

The exploitation of a new area of industrial opportunity for civilian use is normally left by our government to private enterprise. However, in the case of these important space systems, the development investment required is so large that it is beyond the financial resources of even our largest private industry. Furthermore, the use of commercial space satellites will require physical support of government installations as well as financial support.

All of the civilian satellite projects listed here will have direct or indirect military usefulness as well. Furthermore, communication and navigation systems of the type envisaged would be extremely useful in implementing an inspection system which might accompany a disarmament agreement. For these reasons, projects of the type proposed might well be undertaken in cooperation with the military services.

We recommend a vigorous program to exploit the potentialities of practical space systems. The government, through NASA or the Department of Defense, should make available the required physical facilities as well as any extraordinary financial support required to make the undertakings successful.

Organizational machinery is needed within the executive branch of the government to carry out this civilian space program.

Summary of recommendations:

Make the Space Council an effective agency for managing the national space program.

Establish a single responsibility within the military establishments for managing the military portion of the space program.

Provide a vigorous, imaginative, and technically competent top management for NASA, including:

• Administrator and deputy administrator.

• A technical director for propulsion and vehicles.

• A technical director for the scientific program.

• A technical director for the non-military space applications.

• A technical director for aerodynamic and aircraft programs.

Review the national space program and redefine the objectives in view of the experience gained during the past two years. Particular attention should be given the booster program, manned space flight, the military uses of space, and the application of space technology to the civilian activities of the country.

Establish the organizational machinery within the government to administer an industry-government civilian space program.

USAF Balloon Flight Will Carry Telescope

Dayton—First manned balloon flight carrying a telescope for astronomical exploration is planned by Air Force Research Division of Air Research and Development Command for spring or early summer.

Pilot of the balloon and test director will be Capt. Joseph W. Kittinger, who last summer set a world's altitude record when he jumped from 102,800 ft. to prove free fall concepts.

With Kittinger on the projected flight, unofficially called Project Stargazer, will be U. S. Navy astronomer William White of the Naval Ordnance Test Station at China Lake, Calif., scientific director of the project, who is temporarily attached to Northwestern University. Balloon will operate between 50,000 and 87,000 ft.

Previous unmanned balloon telescope-carrying flight was made by the Office of Naval Research in Project Stratoscope.

Stratoscope II flight is scheduled for next fall.

Gondola for the Stargazer flight was built by the Wright Air Development Division here, which designed and developed the sealed vehicle.

Telescope and stabilization platform are under the cognizance of the Massachusetts Institute of Technology. Air Force Cambridge Research Laboratory has cognizance of the balloon, while the Missile Development Center at Holloman AFB, N. M., will launch, track and recover the vehicle. Four flights are planned.

Failures Plague Atlas Space Launchings

By George Alexander

Failure of the Atlas-Able V-B lunar probe, which exploded 68 sec. after liftoff on last Dec. 15, appears to have been caused by a premature ignition and subsequent explosion in the second stage Able.

Two factors are:

• **Accelerometers** aboard the Atlas booster showed a marked deceleration shortly after accelerometers on the upper stages registered a sharp acceleration. This would indicate that the upper stages experienced a strong upward propulsive thrust which, at the same time, applied a negative force on the Atlas. Further, all telemetry on the upper stages went out instantaneously —followed, after a very short time interval, by a shutdown of all booster telemetry. The direction of the failure was downward from the upper stages.

• Observers at Cape Canaveral reported seeing a doughnut-shaped fireball at about the time of the explosion. Engineers say that the only logical explanation for such a phenomenon would be the aerodynamics of the Atlas passing through a fireball above it, i.e., in the upper stages.

Able Performance

Exact cause of premature—by almost 3½ min.—ignition of the Aerojet Able second stage has yet to be determined. Able has a good record aboard Thor and Delta boosters (16 successful starts and normal burnings out of 18 flights excluding failures where the vehicle did not have the opportunity to operate), but the Able modified for the Atlas series has not performed as well. On Atlas-Able V, launched last Sept. 25, the Convair Atlas performed normally and separated from the upper stages. The Able engine, however, ignited roughly, burned abnormally and failed to achieve full power. The payload consequently did not go into orbit.

After the first Atlas-Able IV vehicle exploded during a static test at the Cape, a backup vehicle was launched on Nov. 26. At about 45 sec. after liftoff, the glass fiber protective fairing around the payload and third stage suddenly fell off. Still within the atmosphere, the upper stages were subjected to extreme aerodynamic buffeting and imbalanced forces; the payload and third stage were torn off, falling into the sea.

Investigation later revealed that failure to compensate for pressure differences—at sea level, where the fairing was attached, and at altitude, where it should have properly separated—was the probable cause of malfunction. Tracking data and telemetry showed that the Atlas burned to within a second of the programed time and there were signs that the Aerojet Able engine fired, although separation could not be determined.

After Able IV, all fairings were drilled with tiny holes to preclude a pressure build-up within the fairing and this malfunction was not repeated.

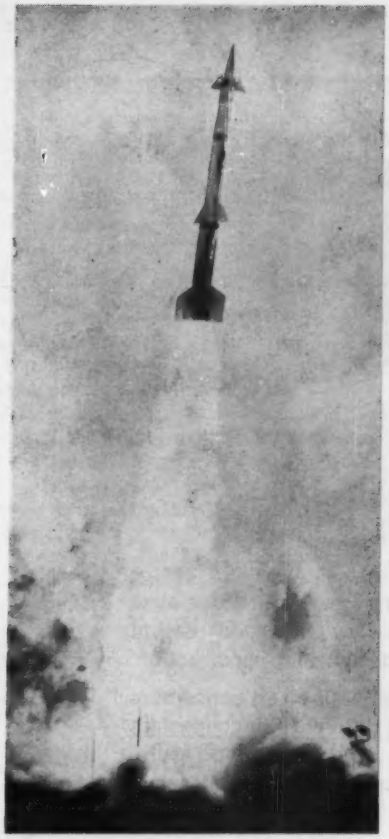
Random failures have plagued those space programs which have employed Atlas as first-stage booster. Only one shot can be considered to have been completely successful, from an over-all mission viewpoint, and that is Project Score—the orbiting Atlas which carried President Eisenhower's 1958 Christmas message to the world. The Atlas itself has performed well in all but one instance.

In the launch of the "Big Joe" boilerplate Mercury capsule on Sept. 9, 1959, the two booster engines of the Atlas failed to separate, thus shortening the flight range by several hundred miles and placing the capsule along a much steeper re-entry angle. When the capsule withstood much higher g forces and temperatures than had been anticipated, National Aeronautics and Space Administration engineers rated the flight test as successful and canceled plans for a second similar shot.

Midas Shot

The first Midas shot, last Feb. 26, resulted in an explosion of both the Atlas and the Agena satellite immediately following separation. USAF has never revealed the cause of malfunction, but it is known that Lockheed made some changes in the adapter section and separator device for subsequent Atlas-Agena flights. Midas II, launched May 24, achieved a near-perfect orbit,

ATLAS-ABLE V-B is shown as it lifted off from Cape Canaveral last Dec. 15. Intended to orbit a satellite around the moon, the vehicle blew up 68 sec. after liftoff. It was the third and final vehicle in NASA's Atlas-Able series.



First Zeus Guided Flight

First guided flight of Army Nike Zeus is made at White Sands Missile Range, N. M. Lear, Inc., shares development of the guidance package with Western Electric Co., prime contractor. The missile was fired by personnel of Bell Telephone and Douglas.

but telemetry aboard the satellite failed after the 16th orbit and the Midas payload did not receive the testing USAF had planned for it.

Samos I, launched Oct. 11 from Pt. Arguello, Calif., lost all gas pressurization required for attitude stabilization at time of liftoff when the umbilical tore off a section of the Agena's skin. Although boosted to the correct velocity by Atlas and although its own engine started, the Agena vehicle was not stabilized and did not go into orbit.

The first Mercury-Atlas launch, carrying a production-line version of the McDonnell capsule, exploded 65 sec. after liftoff on July 29. Although exact cause of malfunction is unknown, NASA is critically studying the structural strength of the McDonnell adapter section (AW Jan. 16, p. 27) and intends to beef up the unit. AVIATION WEEK also learned that telemetry from MA-1 indicated that the shingles along the conical afterbody of the capsule were vibrating at extremely high frequencies, although there is no evidence that any shingle tore loose.

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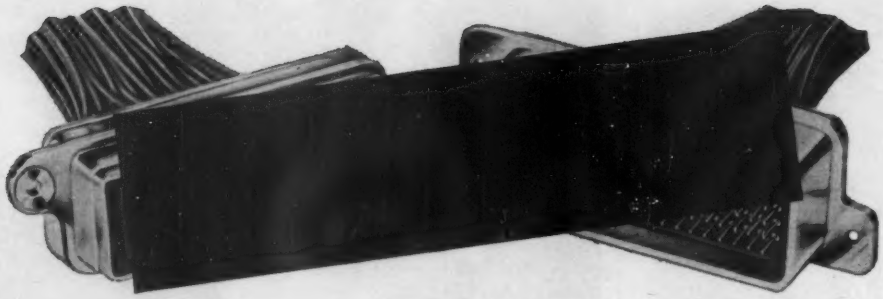

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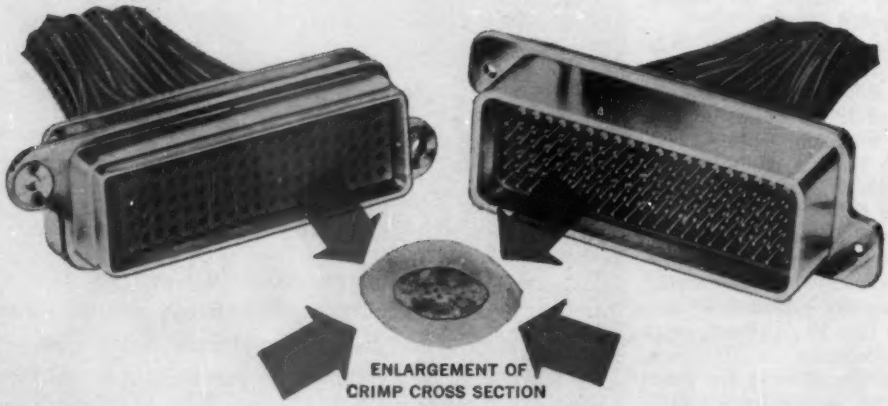

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AGREE Program Reveals Failure Causes

By Philip J. Klass

Philadelphia—Air Force and industry experience indicates that the tough new AGREE reliability procedures are a very effective mechanism for rooting out basic causes of unreliability, both in the equipment and within industry itself.

As a result, Air Force contractors may soon find profit margins in incentive-type contracts pegged to the mean-time-between-failure (MTBF) of the avionic equipment they deliver, as measured by AGREE test procedures.

Results of Air Force and industry experience under the new procedures were reported here at the Seventh National Symposium on Reliability and Quality Control by G. W. Lindsay of the Air Materiel Command in Dayton and by H. L. Hoffman, president of Hoffman Electronics Corp. Hoffman was the first company to undertake a major production contract, for AN/ARN-210 Tacan sets, under the new AGREE procedures (AW June 13, p. 87).

James Bridges, in charge of electronics in the Office of the Director of Defense Research and Engineering, said the results of the use of AGREE procedures "are extremely gratifying," in a statement volunteered from the floor. The AGREE test procedures were developed by the Advisory Group on Reliability of Electronic Equipment (AGREE), under the sponsorship of Bridges' office.

First Trials

The ARN-21C Tacan sets built by Hoffman are just beginning to see field use. There have been so few failures so far that it is not possible to statistically predict the MTBF they can expect to exhibit in field use. However, present indications are that the 150-hr. MTBF demonstrated under AGREE factory tests will be at least equalled in the field, and the figure is likely to reach 250 hr. If so, it would be several times the MTBF figure exhibited by previous ARN-21B sets.

The impact of the AGREE procedures already has been felt by companies that have pioneered in its use. Here are some of the industry comments reported by Lindsay:

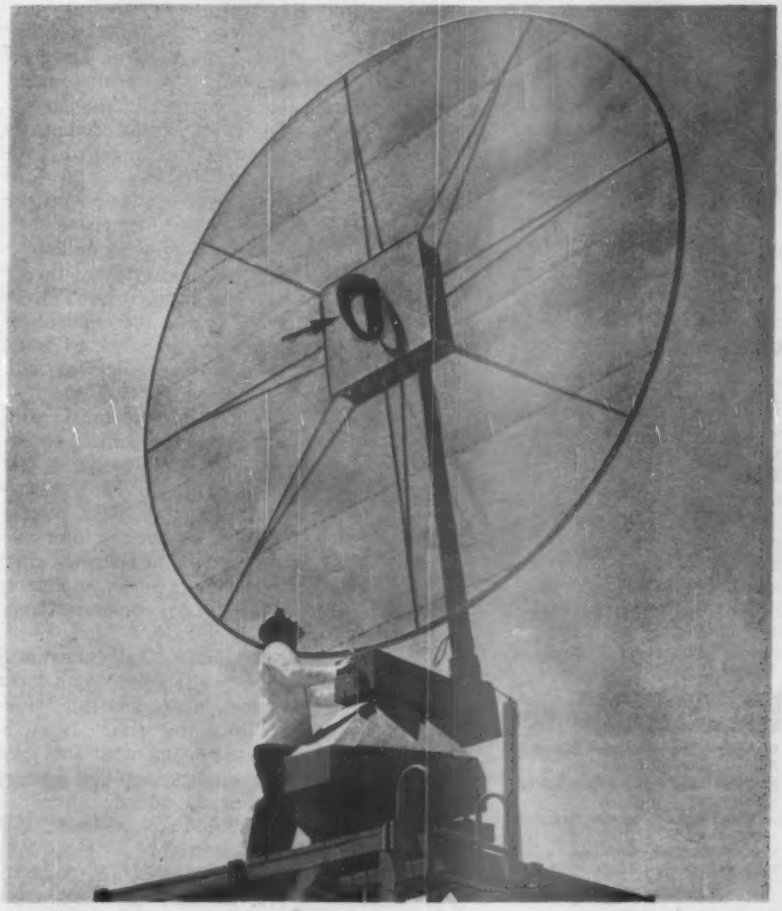
• **Radio Corporation of America,** which built the AN/ARR-60, -61 time-division data links under AGREE procedures: "While we opposed the inclusion of the AGREE reliability requirement during negotiations, we now are glad that it was done as we have learned things about our operation that we did not even suspect."

• **Unidentified manufacturer** of doppler radar: "This (AGREE test) program has contributed more toward product improvement than any reliability program established to date. Former contractually required tests were superficial; field tests lacked controls which are necessary to isolate (faults)."

Hoffman was even more candid in describing the impact of the AGREE procedures on his company, which he said had forced "a complete realignment of our internal procedures." His comments are particularly significant because Hoffman was one of three companies which produced the predecessor ARN-21B Tacan sets.

Moving into ARN-21C production, however, Hoffman had to eliminate sources of 15 waivers that had been granted in performance of ARN-21B equipments, improve sensitivity of the set and raise the operational environment from 50,000 ft. to 70,000 ft. at full power without pressurization, in addition to meeting 150 hr. MTBF under AGREE tests. Hoffman contracted to produce the improved ARN-21C at a lower price than the predecessor equipment and to begin deliveries nine months after the award.

To meet the AGREE test requirements meant that there could be no more than one workmanship mistake



B-52 Electronic Countermeasures Antenna Tested

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per 10 Tacan sets, each of which contained 1,015 electrical components and over 5,000 mechanical parts.

This required "a substantial upgrading of our own workmanship," Hoffman said.

The company had to launch new intensive training courses for its line workers and institute much tighter screening procedures in hiring new workers, which resulted in rejection of 19 out of 20 applicants.

"Some of our supervisors who could not completely face up to the problem realistically had to be placed elsewhere," Hoffman said.

The company found it necessary to drop approximately 85% of its former component suppliers and find new sources to obtain sufficiently reliable components. This despite the fact that the former vendors were producing components that met military specifications. The problem, Hoffman said, was that these specifications were not adequate to meet the rigorous stresses imposed by the AGREE tests.

Gambling Consequences

Hoffman conceded that his company had "gambled more than we knew on the unknown and, consequently, underestimated the magnitude of the job . . . we invested more of the company's money than I had contemplated." Although Hoffman declines to say how much money the company lost on the $40 million contract, unofficial reports place the figure at nearly $8 million.

"We now have a substantial investment in our reliability know-how," Hoffman said, adding that the company is now much better qualified to build sophisticated military equipment with a high degree of reliability.

Hoffman urged the Defense Department to standardize reliability requirements among the three services. He pointed out that the Air Force now is the only service using AGREE procedures on a wide scale. Lack of inter-service uniformity results in increased costs and confusion among both components and end-equipment manufacturers, Hoffman said.

"We need, and need badly, a national reliability policy applicable to all types of military electronic equipment," Hoffman said. Once this policy is established, it must be supported and used by contracting officers at the time of original bidding, he added.

Citing an Air Force estimate that the improved reliability of the ARN-21C sets will save the USAF approximately $125 million in maintenance costs during their operational lifetime, Hoffman urged the military to share the saving and use financial incentive rather than directives to get industry to use AGREE procedures.

Later in the symposium, a top Air

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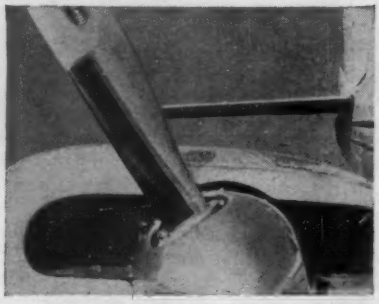

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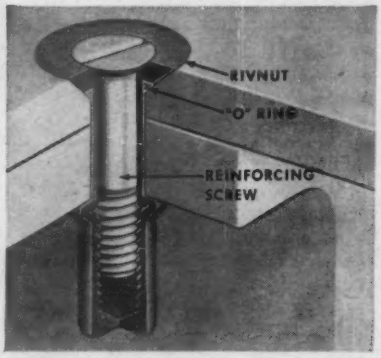

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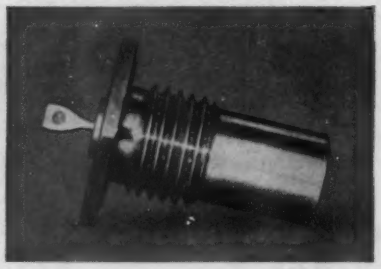

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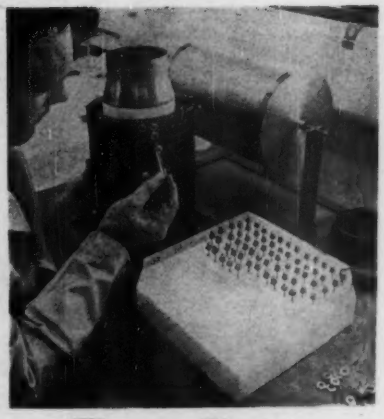

Thermo-Electric Generator

Five-hundred-watt thermo-electric generator subassembly, under construction by Minnesota Mining and Manufacturing Co., is one of two such programs sponsored by Navy Department. Company has developed a number of industrial/commercial applications for thermoelectricity.

Materiel Command official told AVIATION WEEK that the Air Force already has started to do this. He said that profit margin incentives were being directly related to equipment reliability in new contracts.

Air Force experience to date indicates that AGREE tests quickly pinpoint failure patterns which otherwise would not be detected until some time after equipment went into operational use.

Because of the difficulty of obtaining full data on field failures, and because of different usage, maintenance and environment conditions at different bases, early failures frequently appear to be entirely random in nature when in fact they may be non-random and thus indicative of the need for basic changes, AMC's Lindsay said.

Quick Fixes

For example, a new doppler radar navigator, not originally built to AGREE test provisions, had been giving a MTBF in the field of only 3.6 hr., with failures appearing to be completely random. But when two equipments were subjected to 600 hr. of AGREE testing in the factory, eight major failure patterns became apparent, Lindsay reported. This permitted quick fixes which already have raised the MTBF to 4.5 hr., and the contractor is confident that it can raise the figure to more than 20 hr. under AGREE test conditions.

Lindsay cautioned that contracting officers must be extremely careful in selecting the MTBF figure used in a contract and should not just pull it out of the air. If the figure is needlessly high, the service can expect schedule

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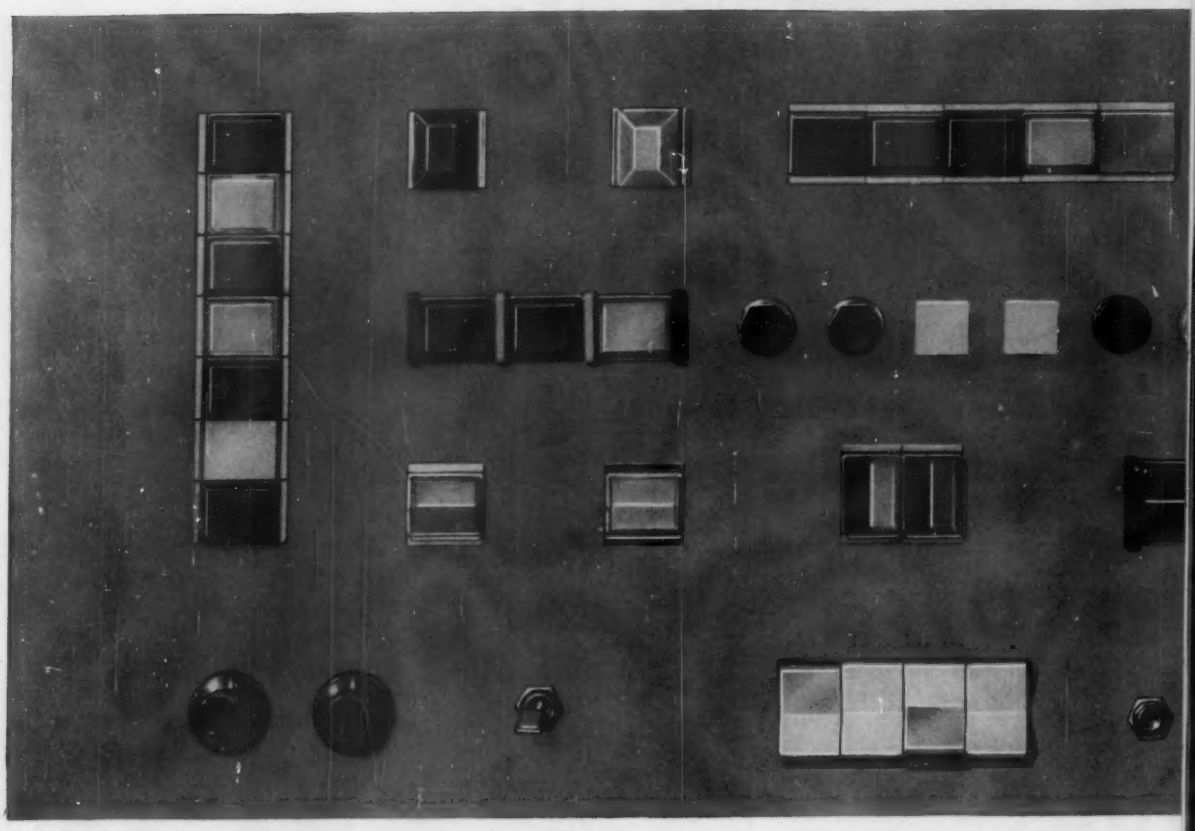

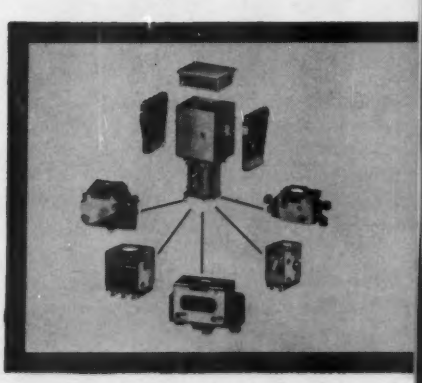

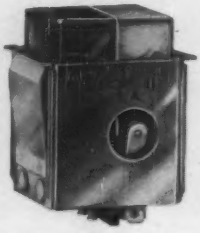

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"302 PB" Miniaturized Lighted Push-Button Switch

Indicator and switch unit with momentary action—actuated only while the button is depressed—both combined in less than one cubic inch. The "302 PB" Series conforms to the requirements of MIL-S-6743, MIL-S-6744 and MIL-E-5272A. Write for Data Sheet 182.

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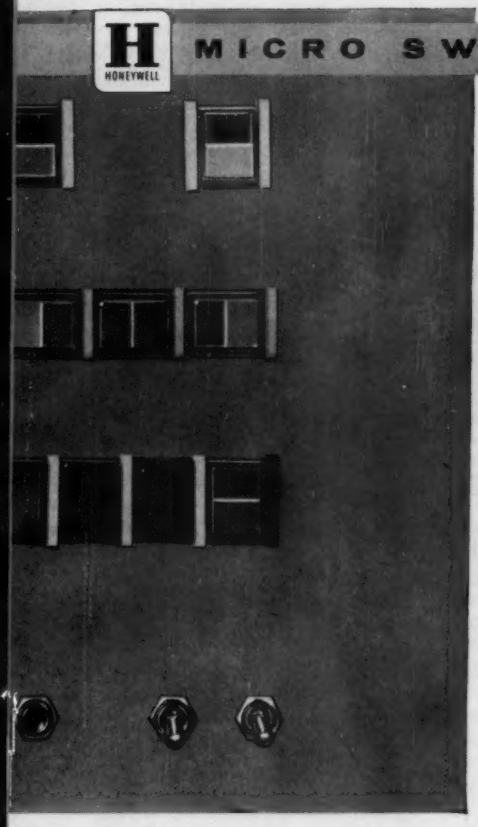

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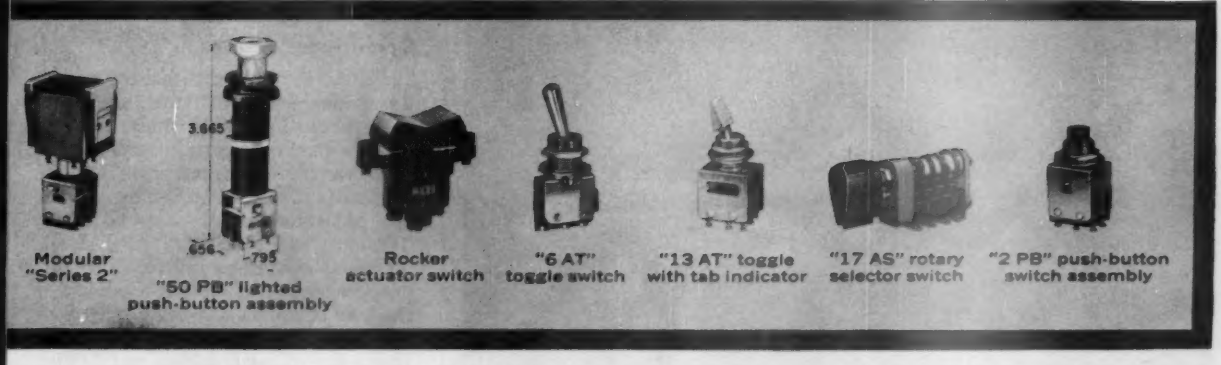

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Photo courtesy of Douglas Aircraft Company

Fuel Resistant O-rings for Jets

Some 500 flexible fuel-line couplings on the DC-8 Jetliner are sealed by special Hadbar O-rings. For safety, the O-rings, like the two exposed above, must retain elastic properties and dimensional stability despite prolonged contact with jet fuel at temperatures from −80°F to +160°F.

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SILICONE NEWS from Dow Corning

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Fuel Resistant O-rings for Jets

The DC-8 Jetliner uses more than 500 flexible couplings on fuel lines. Leakage at any coupling is prevented by two rubber O-rings that must retain their rubbery properties and continue to seal as an O-ring should, despite constant contact with jet fuel.

Douglas engineers, after extensive tests, chose a special rubber compound based on Silastic® LS, the Dow Corning fluorosilicone rubber. Silastic LS resists fuels, oils, most hydraulic fluids and solvents . . . doesn't swell, or become tender.

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slippage, excessive costs and/or the necessity of granting waivers.

Lindsay conceded that the addition of AGREE provisions may add to initial procurement cost and delivery schedule time. However, this is "far outweighed by saving in maintenance cost, by easier logistic support, by increased effectiveness and by reduced numbers of weapon systems required," he said.

One of Lindsay's observations is of special interest to Air Force contractors, particularly those who have been reluctant to set up reliability groups or to give them adequate authority. "Provisions must be made to award contracts containing reliability requirements only to contractors having demonstratable competence."

In a symposium round-table discussion on government procurement practices and their effect on equipment reliability, Maj. Gen. W. A. Davis, commander of AMC's Aeronautical Systems Center in Dayton, cited another example of how a company's reliability capability can pay off. In a recent negotiated procurement, where contract calls for AGREE reliability tests, the two companies that submitted the lowest bid were ones which have well-established reliability groups while the two highest bidders had the poorest planned reliability proposals, according to Gen. Davis. He attributed this to the fact that the inexperienced companies had to put considerably more padding into their bids as a hedge against the unknown.

Operational Study

The Air Force recently has contracted for a one-year operational study by Vitro Corp. for a field study of three F-101 squadrons, each at a different base, which are outfitted with the new ARN-21C Tacan sets. The three bases are Malmstrom and Glasgow AFBs, Montana, and Charleston AFB, S. C.

One of the major objectives of this program is to evaluate the reliability of the new equipments in field use and to determine what correlation exists between the AGREE factory test MTBF figures and those obtained in actual use.

If this study shows significant improvement in the reliability of the ARN-21C over its predecessors, observers expect that the AGREE test procedures will become a standard provision of most USAF procurements.

Navy's Bureau of Weapons, which has not yet issued any contracts with the AGREE provisions, plans to subject its new AN/ARN-52 miniature Tacan sets, being developed by ITT Federal Laboratories, to the AGREE tests and to compare the results with other reliability test procedures to determine their appropriateness for Navy airborne applications.

Microelectronics Studies Gain Support

By Barry Miller

Los Angeles—The armed services plan to fund a number of development programs in microelectronics early this spring in a new round of support for promising techniques which, they hope, will yield small, reliable and low-power components and circuit functions for future avionic systems.

All of the projected programs are small, compared with the multi-million dollar efforts funded by the Air Force and Army at Westinghouse and Radio Corp. of America, respectively. The Navy, which has remained aloof from any heavy commitment to microminiaturization in recent years, will go into microelectronics with at least three separate—not too sharply defined—efforts, two of them quite modest in scope. These will supplement the limited work that service has supported over the years through its participation in the Army-Navy Instrumentation Program (ANIP).

Industry proposals are being evaluated and contracts are expected to be awarded by this spring for:

• **Combination thin film circuitry** and epitaxial semiconductor program sponsored by the Electronic Technology Laboratories of the Air Force's Wright Air Development Division. Proposals for this program, which is to be a three-year effort, were due in Dayton, Ohio, at the year's end and an award is expected by mid-March. Funding reportedly will be at the rate of $450,000 to $550,000 a year.

• **Connection and protection** techniques effort which would involve development of a unified and compact method of connecting and interconnecting functional electronic blocks, long regarded as the chief obstacle to realizing the high component density potential of various microminiaturization approaches. This will be a two-year effort to be funded at about $100,000 a year by the Electronic Technology Laboratories.

• **Circuit optimization** for microelectronic applications program, scheduled as a three-year study and development effort to determine compatibility of thin films, integrated circuits, etc., for Army's continuous wave communications and digital data processing gear. Slightly under $100,000 is available for the first year of this program. Proposals for this contract are being evaluated by the Army Signal Research and Development Laboratory, Ft. Monmouth, N. J., and an award is expected in early March. This program is unrelated to and involves a different concept than the micromodule program and its associated contracts.

• **Deposition of thin films** of complex dielectric compounds. Proposals for this Signal Corps contract are deadlined for receipt at Ft. Monmouth Jan. 23. Dollar value of this award is estimated to be below $100,000.

• **Ceramic micro transistor** package capable of being employed in the micromodule program. This two-year contract will involve repackaging a silicon switching transistor, the 2N697, into a ceramic package 40 mils in height and 225 mils in diameter. The device is required to have 300C storage capability. Contract for a similar type of "pancake" package, this one in glass, recently was awarded to Sylvania Electric. The ceramic package contract is expected out of Ft. Monmouth in March.

• **Semiconductor surface** passivation techniques study to be funded by Air Force's Cambridge Research Laboratories.

• **Development of batch deposition** techniques, deposition monitoring devices, continuous deposition techniques and extended materials research under a Navy advanced technology program. Up to four contracts, probably totaling several hundred thousand dollars, may be awarded this spring, by Navy Bureau of Weapons avionics facility in Indianapolis (AW Jan. 9, p. 23). These efforts, Navy hopes, will enable it to set up an experimental plant production line at Indianapolis to make and evaluate microcircuits.

• **Renegotiation** of an expired Air Force contract with Texas Instruments for Solid-Circuits.

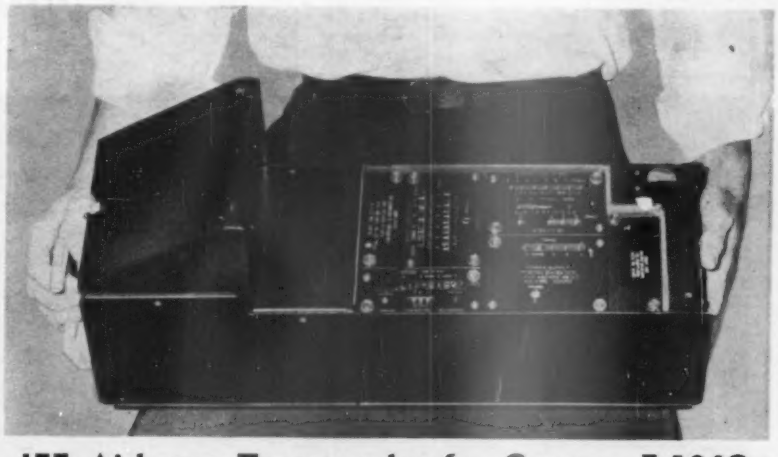
Besides these forthcoming awards, other armed services' requests for proposals in microelectronics are expected throughout the early months of this year. The Signal Corps is believed to be weighing the merits of a competition for a contract covering single crystal semiconductor deposition on dielectric substrates.

In addition, under Navy Bureau of Ships auspices, the Naval Electronics Laboratory at San Diego began setting up a laboratory several weeks ago to conduct small-scale research and development in microelectronics. This new laboratory will explore the value and applicability of different microelectronic techniques for specific naval systems. As part of this work, NEL's Microelectronics Laboratory will subcontract to industry the task of building certain equipments, each made by different micro techniques so that it can evaluate them on a comparative basis.

Navy's Space Interests

Navy is known to have a strong interest in avionic microminiaturization techniques for its growing astronautics program. It will use part of the $11 million earmarked for the program in the Fiscal 1962 Eisenhower budget for applying these techniques to the design and construction of smaller, cheaper comparatively low-orbit satellites (AW Jan. 2, p. 41).

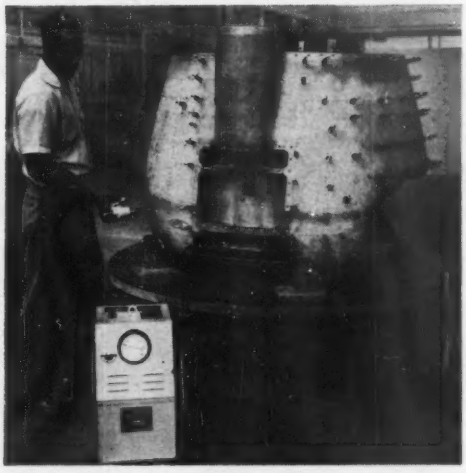
For some time, a special Navy microelectronics panel has been monitoring scores of industry and government-sponsored microminiaturization efforts. Indications are that the Navy is about to push several possible efforts. Besides the avionic facility and Naval Electronics Laboratory efforts, another laboratory to evaluate microelectronics is being set up by Bureau of Weapons at



IFF Airborne Transponder for German F-104Gs

IFF airborne transponder, AN/APX-46 (V), for radar identification, has been selected by West Germany for use on its F-104Gs. The transistorized transponder developed and produced by Hazeltine Corp. is being used by U. S. and Canada.

SONIC VIBRATION PROBLEMS ON DC-8 SOLVED BY BLIND BOLTS



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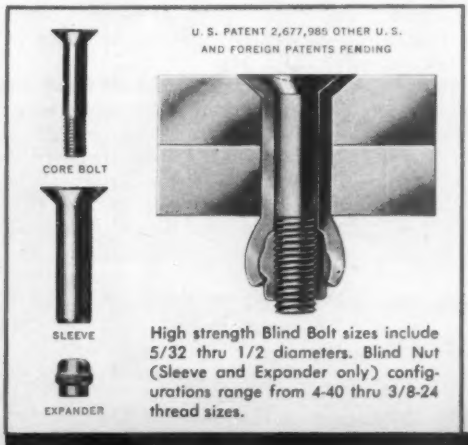

High strength Blind Bolt sizes include 5/32 thru 1/2 diameters. Blind Nut (Sleeve and Expander only) configurations range from 4-40 thru 3/8-24 thread sizes.

Blind Bolts were finally selected by Douglas DC-8 engineers for use in the Sound Suppressors. Exhaustive tests of various blind fasteners determined that Blind Bolts in temperature areas could best resist overall sound pressure levels reaching 150 decibels!

In this unusual application, the remarkable ability to the Blind Bolt to resist sonic vibrations stems from several of its inherent design features...the *twin locking technique,* combining the oval lock of the Expander to grip the thread of the Core Bolt and the wedge lock between the Expander and Sleeve end...*the hole filling ability,* resulting from the expansion of the Sleeve shank during the installation pull-up of the Expander into the Sleeve end...and lastly, *the excellent fatigue resistance,* gained from the high tensile preload imposed by the Core Bolt and from the cushioning effect of composite fastener materials.

Because the coefficient of expansion must remain the same to prevent loss of fastener preload, the compatability of structural materials at high temperatures is essential. Inside the stainless steel Ejector where exhaust gases reach 900°F., A-286 stainless steel Blind Bolts are used. On the outside where structural temperatures reach 300°F., Type 431 stainless steel Blind Bolts are used.

From the shop viewpoint, Blind Bolts are installed rapidly and quietly. Hole preparation is simple, no reaming is required. Only Blind Bolts offer a choice of gun driving tools designed for repairs or modifications in difficult or tightly congested structural areas.

If sonic vibration is your fastener problem...consider Blind Bolts. Write for brochure.

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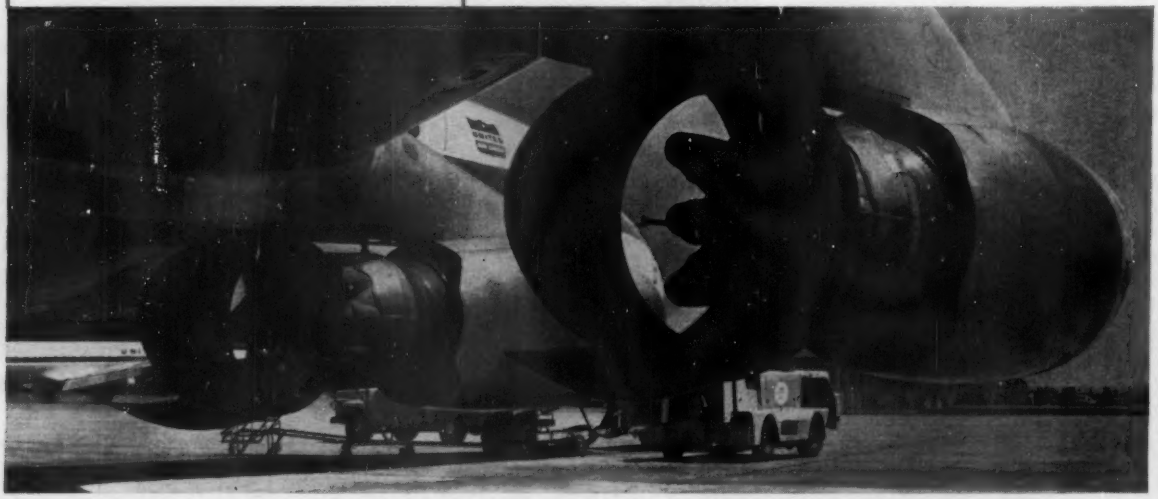


Johns Hopkins Applied Physics Laboratory.

Function of the advanced technology program at the avionics facility, according to a Navy representative, is to evaluate various approaches to microelectronics, not to initiate a new approach. For this, specialized equipments will be assembled to produce microcircuits for extensive evaluation. Navy insists it has not fixed on any specific approach although it concedes thin films are a leading idea. Several industry sources, however, indicate that what the Navy wants, as outlined in the proposal request, bears a striking resemblance to the thin film approach of one large company as set forth in its reports for another government contract.

Industry Criticism

There has been strong feeling in the avionics industry for some time that armed services-supported work in microminiaturization lacks coordination and is characterized by too much duplication. Moreover in some services—particularly the Air Force—this widespread view continues, frozen on a single approach which cannot satisfy all avionic needs quickly enough. Consequently, some of the forthcoming programs, while monetarily small, are welcomed by industry as belated practical studies which, this view argues, should have preceded service commitments to one or two of the programs it now supports.

Total service funding of microelectronics, including complete investments in the micromodule, solid-circuit and dendritic growth processes, exceeds $20 million. One estimate places 40 avionic companies in the microelectronics field with each one investing an average of $2-3 million, including armed services support.

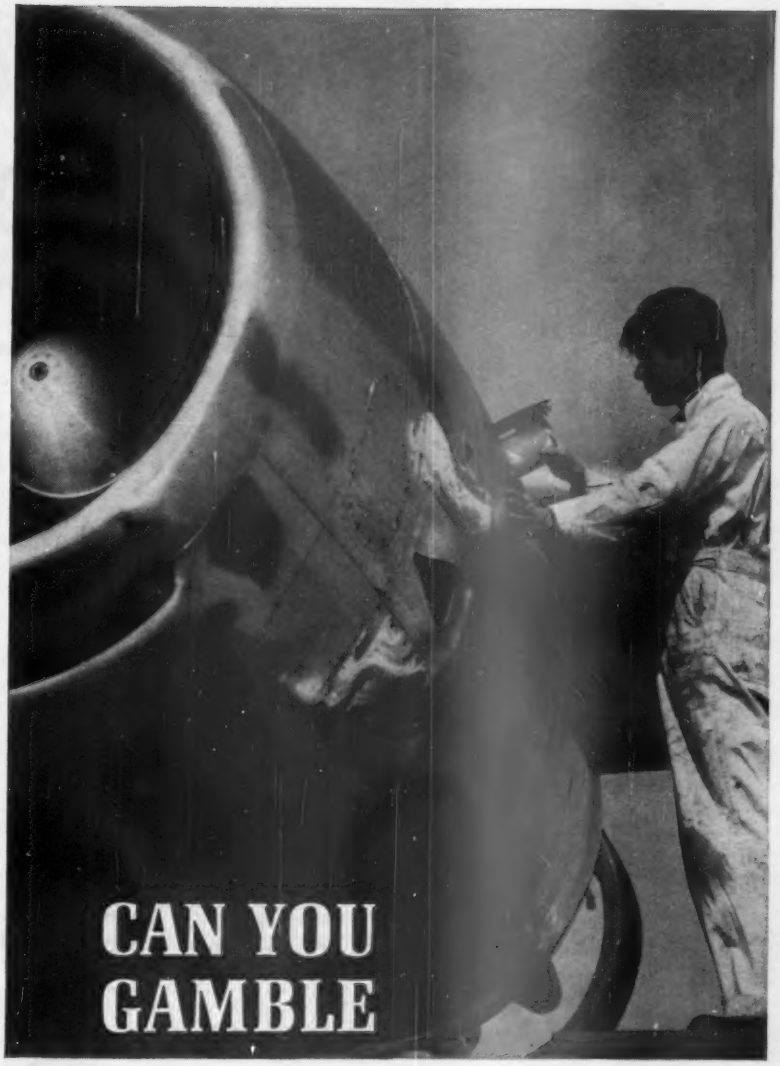
Aim of the combination thin film/epitaxial semiconductor program at WADD will be to develop compatible techniques for fabricating complete circuit functions by combining thin film technology and semiconductor techniques. Epitaxial semiconductor growth—that is deposition of one semiconductor layer on another whose crystal structure is identical—will figure prominently in this study.

Specific Goals

Among the specific goals of this program will be to learn to make:

- **Semiconductor** P and N layers of controlled thickness.
- **Multiple** P and N layers with controllable lifetime and impurity concentration.
- **Single crystal formation** on insulating substrates.
- **Graded** and abrupt junctions.

The Signal Corps' dielectric compound program, entitled "Study of Thin Film Compounds Formed from Simul-



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New Technical Bulletin 409B describing azelate-based jet lubes is available by writing Dept. Z-1A.

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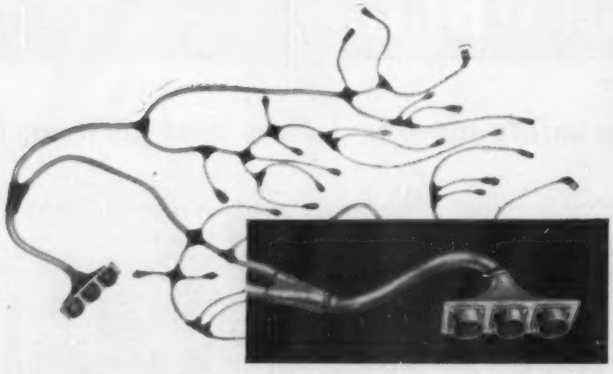
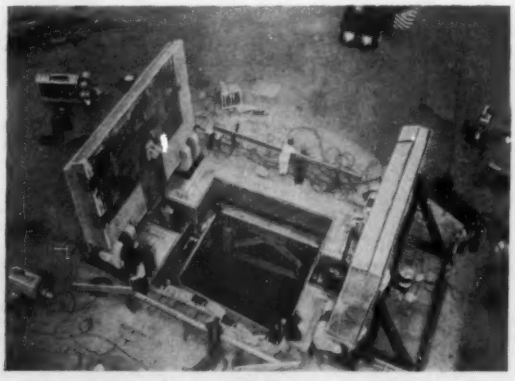
General Electric Silicone Rubber helps get Titan ICBM combat-ready

Missile and ground-support applications are "naturals" for the unique qualities of silicone rubber—heat resistance above 600°F, low-temperature flexibility to −150°F, good thermal conductivity, unexcelled ozone resistance and virtually unlimited life under normal conditions. Because it retains its excellent electrical properties over a wide temperature range, G-E silicone rubber is also used for missile wire and cable insulation. Even when continuously exposed to direct flame, it forms a non-conducting ash which gives off no toxic fumes.



Missile wiring harness—General Electric silicone rubber was chosen by Aerojet-General Corp. for the Titan's propulsion system wiring harness. Breakouts and junctions are molded from G-E RTV (room temperature vulcanizing) silicone rubber; wiring is silicone insulated; jacketing is high-strength G-E silicone rubber. Inset shows silicone rubber inserts in connectors. RTV is used in other missiles as a shock-absorbing encapsulant and potting material for electronic assemblies.



200 tons of steel and concrete—Titan missile silo doors by American Machine & Foundry Co. use seals of G-E silicone rubber. AMF also used G-E silicone rubber door seals on the Titan's ground support entry portals and radar silos. Silicone rubber can withstand the heat of rocket blast-off or possible atomic attack while remaining stable in storage for long periods.

Write for more information on G-E silicone rubber, briefly describing your application. Section JJ134, Silicone Products Department, Waterford, New York.

GENERAL ELECTRIC

taneously Evaporated Constituents" will be directed at inorganic compounds, including barium titanate. A possible second phase of the program will involve a study of ferromagnetic materials.

Signal Corps' circuit optimization program will attempt to study the effects of system requirements on microelectronic circuit design and the subsequent relation between microelectronic circuit specifications and component selection. Final program objective is to secure data which can be employed in determining whether a specific microelectronic approach satisfies a system's requirements.

The three-year program will be divided into two phases:

• **Phase I**—Theoretical and experimental investigation to get data and set criteria to be used in applying microelectronics to digital data processing and continuous wave communications systems.

• **Phase II**—Verifying Phase I results by reduction to practice. Phase II will constitute almost a third of the second year effort, better than two-thirds of the third year's effort.

The contractor will have to select typical digital data processing systems requirements such as speed or bandwidth, power level, noise level, ambient temperature based on Signal Corps systems. He will then choose specific circuits, such as bistable multivibrators, "AND" and "OR" gates, inverters and pulse amplifiers. These will be investigated to optimize power dissipation, reliability, adjustability, topology, interconnection and compatibility.

Thus, for example, minimum power dissipation levels would be determined for the selected circuit types considering factors such as speed requirements, signal and load power requirements, compound tolerances, noise immunity and environmental conditions. This information would then be used in determining allowable component densities and geometrical layouts and also in reliability studies.

The most promising microelectronic techniques would then be compared on a point-by-point basis in view of this investigation. The merits and limitations of each can be summarized as to their ability to satisfy the most critical system requirements. The contractor would make specific recommendations as to the needs of each fabrication technique in the way of additional hardware development and specify which techniques are ready for use in digital data processing systems.

In Phase II the contractor will select the most promising technique and fabricate a digital data processing system which could test the validity of the finding of Phase I.

Biorhythm Theory Claims Ability To Spot Accident-Prone Periods

New York—Pocket-sized mechanical computer designed to pinpoint periods during which humans may be particularly accident-prone is attracting some serious interest in U. S. aviation circles.

The computer, made in Switzerland and distributed in this country by Biorhythm Computers, Inc., is based on a theory of biological rhythm generally credited to Dr. William Fliess, a German physician and biologist, who first propounded the idea in Europe around the turn of the century.

The Fliess biorhythm theory reportedly caught on in Europe after World War II where, it is said, the theory now is being used to schedule pilots, drivers, athletic training and competition, surgical operations, and so on. In this country, the Fliess theory appears to be getting an interested, skeptical but not hostile reception. Those familiar with the theory say they have not yet seen adequate scientific validation for it. At the same time, they are unwilling to dismiss it as mere astrology or superstition; rather, most of them want to see more scientific evidence developed, for or against the theory.

R. M. Woodham, associate director of the Daniel and Florence Guggenheim Aviation Safety Center at Cornell University, is convinced that the theory shows sufficient value to justify further research. Dr. James L. Goddard, medical director of the Federal Aviation Agency, plans to test the theory with a null hypothesis as a preliminary to possible further investigation.

FAA Bureau of Aviation Medicine will shortly submit a list of names and birth dates of pilots to Biorhythm Computers, Inc., and request that the firm chart the critical (most accident prone) days of each pilot for a given year. Some of the pilots on the list will have been involved in accidents during that year; others will not. FAA then will match the critical days against actual accident days.

According to the Fliess theory, every human being has three different, natural rhythmic cycles which begin the day he is born. The first is a 23-day physical cycle, governing strength, endurance and the like. The second is a 28-day emotional rhythm concerned with moodiness, creative ability, intuition, ease of expression, etc. The third is a 33-day intellectual cycle representing

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trouble grows in tired metal

The enlarged piston section at the right has a fatigue crack. It is almost invisible to the naked eye, even though an etch treatment has been used to make cracks easy to see. If the inspector doesn't spot this crack at overhaul, it will grow and become as dangerous as the one in the piston at the left.

Airwork uses two separate methods of piston crack determination; (1) etching treatment, followed with a binocular microscope of the critical areas, (2) Zyglo inspection. We have some of the most extensive black light inspection facilities in the East.

You can't afford less than the best available inspection of your engine at teardown. That's one more reason why an Airwork overhaul is good insurance of reliable performance.

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December, 1960

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intelligence, mental alertness, power of concentration, responsiveness, memory and so on.

All three periods can be represented on charts by sine curves. The first or positive half of each cycle is the time of increased efficiency, and the second phase, a time of decreased efficiency. Those days during which the cycle sine curve changes phase—that is, at the beginning, middle and end of each period —are considered critical days, particularly with regard to the physical and emotional cycles. On these days, individuals are considered to be seven to eight times more accident prone.

The pocket computer, which comes in two models selling for $35 and $45, is designed to save individuals the trouble of making the arithmetical computations necessary for charting their biological rhythms. Once the unit is set for the individual's birth date, he simply moves it ahead each day like a calendar and notes his conditions with reference to the three cycles represented on the face of the computer.

There are many familiar examples of periodicity apparent in living organisms, Northwestern University biology Prof. Frank A. Brown Jr., points out. For the most part, they are related to regular geophysical cycles, such as the sleep pattern of plant leaves which is based on the 24-hr. solar day, and the human female menstrual cycle geared to the 29½-day synodic month. Other rhythmic phenomena based on such "odd" periods as 22 hr. and 27 hr. are quite common in living organisms.

But a great deal of research is required to establish the origin and immutability of these rhythms and to understand their functioning and the factors that influence this. These are some of the things that Prof. Brown and his group at Northwestern are studying under grants from the Office of Naval Research, U. S. Public Health Service and National Science Foundation.

Starting with investigations of animal and plant periods geared to geophysical rhythms the Northwestern group is trying to "build up the necessary scientific evidence step by step." Later, it plans to investigate cyclic periods peculiar to individuals and not necessarily or apparently geared to geophysical phenomena. But human biorhythm theories such as Dr. Fliess' are too complex a subject to tackle at this early stage in the investigations, according to Prof. Brown.

Investigations of these rhythmic phenomena in living organisms are expected to produce data of value in many different areas, not the least of which are aviation and space flight. However, says one scientist, up to now the problem has been that these phenomena have produced numerous proponents but little scientific data.

FILTER CENTER

► **Multiple Level Maser Developed**—Westinghouse Electric's Air Arm Division has developed a promising new four-level Maser amplifier, using a new material, which can amplify at frequency considerably higher than the pumping frequency. Development of the new Maser, which operates at higher frequencies in the microwave band, is now being sponsored by Wright Air Development Division. First four-level Maser, developed by University of Michigan Willow Run Laboratories, employed ruby crystals instead of more exotic material used by Westinghouse.

► **New Year, New Firm**—Systronics, a new company formed at Torrance, Calif., for manufacturing and marketing peripheral data processing equipment, began operations at the first of the year with the introduction of two new products—a simplified tabulating card reader and a punched tape reader—both with the trade name Raeden. Company also will build a data-type printer and will supply auxiliary keyboards to required specifications.

► **Soviets Report Pattern Recognition Effort**—Five programs for automatic pattern recognition were reported by scientists at a recent meeting of the Soviet Scientific Council of Cybernetics, Academy of Sciences. These include:

- **Letter recognition** by line scan and minimal description, under study by V. M. Glushkov at the Computing Center of the Ukrainian Academy of Sciences.
- **Image scanning** by following the outlines of letters, used in a machine under development by V. A. Kovalevskiy.
- **Identification** of constant features of letters, by means of standard television techniques, used in a reading machine developed by A. D. Krisilov of the Odessa Electrical Engineering Institute of Communications.
- **A quasi-topological** method of letter recognition by V. M. Tserlin.
- **A computer** manipulated system for analyzing Cryillic letters which separates characteristic features by means of vertical line scanning, developed by A. G. Vitushkin. Soviet scientists also discussed self-learning machines as applied to reading devices.

► **FAA Approves Sperry Autopilot**—Sperry Gyroscope Company's new SP-40 automatic pilot has received formal certification for use on the Grumman Gulfstream. Company reports it holds more than $1 million in orders for the new autopilot, which also is being used on Lockheed's JetStar.

► **Components Sales Forecasts**—Transistor sales in 1961 are expected to increase 38% over the 130 million units sold in 1960, with dollar sales up 20% from the 1960 totals, according to a forecast by L. Berkley Davis, vice president and general manager of General Electric's Electronic Components Division. Of the projected $360 million transistor sales for 1961, 50% is expected to go into military products, 36% into industrial use, and the balance to the consumer market. Receiving tube sales in 1961 are expected to total $322 million, about 4% below the 1960 total. If this forecast proves correct, it will be the first year that transistor dollar sales topped those of receiving tubes.

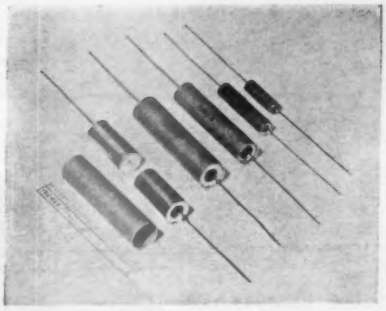
► **NBS Alters WWV Time Signals**—On Jan. 1, the National Bureau of Standards retarded the time signals broadcast from its stations WWV and WWVH by five milliseconds in an effort to obtain closer agreement with other standardized frequency broadcasting stations throughout the world. Simultaneously, NBS resumed the broadcasting, on WWV, of a special binary coded signal giving the day, hour, minute and second.

► **Computer Survey Stymied**—Attempt by Electronic Industries Assn. to obtain statistics on the sales of computers and data processing systems has been frustrated by refusal of two of the nation's largest producers to cooperate in the survey. Without the cooperation of these two companies, the data would be of little value.

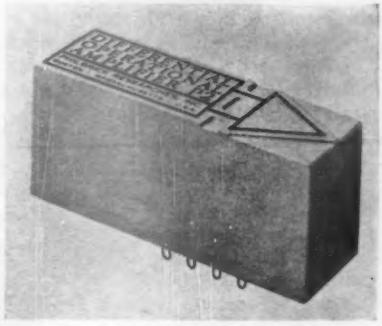
NEW AVIONIC PRODUCTS

• **Digital time generator,** Model 320, for system control and synchronization, provides time-base accuracy of 5 parts in 100,000 for any clocked interval. Device provides two types of outputs: timing markers at 0.001 sec. intervals, obtained from tuning fork oscillator, and at 0.01, 0.1 and 1 sec. intervals by

means of transistor flip-flop dividers, plus decimal outputs to 23 hr. 59 min. and 59 sec., simultaneously displayed on six glow-tube indicators. An optional set of outputs duplicates decimal values in binary coded decimal format. Model 320 is priced at $2,950. Lockheed Electronics Co., P. O. Box 446, Metuchen, N. J.



• **Non-polar solid tantalum capacitors,** Series N for a.c. circuit use, consist of two Series J capacitors of identical value made non-polar by back-to-back connection inside a rigid plastic sleeve. Non-polar capacitors are available in values ranging from 0.16 to 160 microfarads and in working voltages of 6 to 50 v. for continuous operation at 85C or up to 105C if working voltage is de-rated by 15%. Manufacturer: Kemet Co., 11901 Madison Ave., Cleveland 1, Ohio.



• **Differential operational amplifier,** Model P2, a d.c. differential amplifier whose input is entirely floating, has a long-term drift stability in the sub-millivolt region. With typical input current less than 0.1 milli-microampere, device can be used for long time-constant integrating circuits or in electrometer amplifier circuits. Amplifier, containing neither tubes nor mechanical choppers, has open loop gain over 30,000 with frequency response providing roll-off with unity-gain-frequency above 75 kc. Amplifier measures approximately 1¾ x 1⅛ x 4 in. Manufacturer: George A. Philbrick Researches, Inc., 127 Clarendon St., Boston 16, Mass.

• **Subminiature fork oscillating unit,** Type 25, measuring ⅜ in. diameter and approximately 2½ in. long, weighs 2 oz. Precision tuning fork, mounted on seven-pin miniature base, comes in stock frequencies of 400 and 500 cps., but is available at other frequencies of 200 to 1,000 cps. Units come with tolerances of 0.02% over temperature range of −65C to 85C or −65C to 125C, depending upon type. Manufacturer: American Time Products, Inc., 61-20 Woodside Ave., Woodside 77, N. Y.

Said J. Stefan and L. Boltzmann: *"The total radiation from a black body is proportional to the fourth power of the absolute temperature of the black body."*

Radiation is usually associated with high temperatures. Yet very cold bodies emit a radiation which can be highly significant in missile and space applications. The problem faced by infrared scientists, trying to detect variations in radiation from low temperature atmospheres, can be likened to detecting a one-foot cube of ice from a distance of five miles.

Lockheed Missiles and Space Division scientists are deeply engaged in studying the problems of infrared emission from the earth and its atmosphere, as seen from orbital altitudes. Although the earth resembles a black body at 300° Kelvin, the emission from its atmosphere, under some circumstances, is much colder. To make measurements under these circumstances, Lockheed has evolved radiometric equipment with one of the most sensitive detection systems yet conceived.

Scientists and engineers must also take careful measurements of a potential employer. Lockheed Missiles and Space Division in Sunnyvale and Palo Alto, California, on the beautiful San Francisco Peninsula, invites this close scrutiny. As Systems Manager for the DISCOVERER, MIDAS and SAMOS satellites and the POLARIS FBM, Lockheed preeminence in Missiles and Space creates positions in many disciplines for outstanding engineers and scientists.

Why not investigate future possibilities at Lockheed? Write Research and Development Staff, Dept. M-13A, 962 West El Camino Real, Sunnyvale, Calif. U.S. citizenship or existing Department of Defense industrial security clearance required.

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AIA Forecasts $11 Billion 1961 Sales

Aerospace industry sales for 1961 are expected to continue at the $11 billion level, the same as in 1960 and 1959, according to Gen. Orval R. Cook (USAF-ret.), president of the Aerospace Industries Assn.

Manned aircraft are still the backbone of the nation's forces and constitute 36% of current aerospace weapons expenditures, Cook said in his annual review of the industry. But he added that production of military aircraft will continue to decline due to their increasing performance capabilities and because of the steady transition to missiles for military weapons and space exploration.

Production of military aircraft dropped from 1,700 units in 1959 to about 1,200 in 1960. Increasing expenditures for missiles and space vehicles partially offset this decline. Expenditures for procurement and production of missiles increased to an estimated $4.1 billion for Fiscal 1960.

Employment in the aerospace industry continued to decline in 1960 and reached the lowest level since 1955. Employment at the end of September, 1960, was 639,700, and is expected to remain near level for the first few months of 1961. This figure is 18% (252,000 workers) less than the peak postwar employment level of April, 1957.

The AIA review noted that sales of commercial aircraft, engines, propellers and parts are estimated at $2.2 billion for 1960, compared with $1.7 billion for 1959.

Production of commercial aircraft, including helicopters, is expected to total 8,000 units for 1960, compared with 8,242 units produced in 1959. About 230 turbine-powered transports were delivered in 1960, compared with 260 units in 1959.

Aircraft manufacturers in the United States had orders for more than 258 turbine-powered transports, worth more than $1.2 billion, as of Oct. 31.

Annually increasing military expenditures in missile and space areas have resulted in reduced weapons inventories and a shift from mass production to precision fabrication of very limited quantities, Cook said. This trend has caused a decline, since 1958, in the number of production workers and has increased the requirement for engineering and technical skills.

Total plant area requirements have been halved in the last three years and they will be halved again in the next three years, Cook said. There also has been high obsolescence in other facilities. To keep pace with changing requirements and scientific advances, the industry has had to acquire almost $2 billion of new facilities in the past five years. These new research and development and fabrication facilities must be financed from company earnings which have fallen steadily.

Third-quarter 1960 sales for the aerospace industry totaled $3.132 billion compared with $3.167 billion for the comparable 1959 period. Net worth (stockholders' equity) of the aerospace industry was $2.503 billion for the 1960 third quarter, an increase from $2.413 billion for the 1959 third quarter. Net profits for the industry declined to $40 million for the 1960 third quarter from $41 million for the 1959 period.

Profits per dollar of sales declined from 3.8 cents in 1955 to 1.5 cents in 1959. As a percentage of net worth, profits dropped from 21.4% in 1955 to 8.0% in 1959.

The low profit level of the aerospace industry is due principally to contract stretchouts, economic limitations and proportionately more research and development contracts than production contracts, Cook said.

Sales of the 12 major airframe manufacturers are expected to increase slightly from the 1959 figure of $7 billion.

Three of these companies—Convair Division of General Dynamics, Douglas and Lockheed—reported substantial losses in 1960. Lockheed took a first-half net loss of $55,409,000 on the Electra turboprop transport (AW Aug. 15, p. 51). General Dynamics took a $96.5-million pre-tax writeoff in the third quarter, which includes total pre-tax charges for the Convair 880 and 990 jet transports of $221.5 million (AW Oct. 3, p. 47). Douglas wrote off DC-8 jet transport development charges of $27,210,000 and production losses of $28,347,000 for the nine months ended Aug. 31, bringing total DC-8 charges against earnings to almost $300 million (AW Oct. 31, p. 41).

The aerospace industry backlog totaled $12.5 billion on Sept. 30, 1960, compared with $12.1 billion on Dec. 31, 1959. The backlog for military products other than aircraft accounted for the increase, offsetting the continued decline in orders for military aircraft, Cook said. The industry's commercial backlog declined somewhat during 1960 as deliveries of turbine-powered transports increased. The backlog of orders for piston-powered transports has practically disappeared.

During the first seven months of 1960, aviation exports of civil and military equipment increased 88.8% over the same 1959 period. This reversed the trend experienced during the period 1956-1959, Cook pointed out.

The production and sale of business and utility aircraft has more than doubled in the period 1954-1959. The industry delivered 7,400 units in 1960 with a retail value of about $190 million, compared with 7,689 units worth about $173 million in 1959.

Cook reported that the number of commercial helicopter operators in the United States and Canada increased from 160 in 1959 to 193 in 1960. The number of helicopters in service in these nations is 705.

Average hourly wages in the industry continued to rise in 1960, advancing to $2.73 in September from a 1959 annual average of $2.62. Corresponding weekly wages have increased 4% to $110.84 in September, 1960, from the 1959 annual average of $106.63.

Air Force Code

Washington—Air Force uses this code to indicate the general categories in which its systems are classified:

- **100—Strategic Systems.**
- **200—Air Defense Systems.**
- **300—Tactical Air Systems.**
- **400—Control and Support Systems Development.**
- **500—Operational and Support Systems Development.**
- **600—Advanced Development Programs.**
- **700—Applied Research.**
- **800—Basic Research.**

Abbreviations which sometimes appear with these number series are WS for Weapon System and SOR for Specific Operational Requirement.

Atlantic Research Sees 1960 Sales Gain

New York—Atlantic Research Corp. sales for 1960 are expected to total $13 million, compared with $8,315,163 for 1959, and sales for 1961 may climb to $20 million, Dr. Arch C. Scurlock, president, told the New York Society of Security Analysts.

Net profits are estimated at $820,000

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for 1960, compared with $438,614 for 1959. Per-share earnings of Atlantic Research are expected to be $1 for 1960 and $1.50 for 1961; they were 57 cents per share for 1959. Figures are for Atlantic Research Corp. alone and do not include subsidiaries.

Half of the company's work is in the area of solid propellants. Atlantic Research is currently getting 2% of the nation's solid propellant business, "and we intend to go into as big and as expensive solid rockets as we can get contracts for," Scurlock said.

In 1960, 41% of the company's business volume was in the area of hardware development, 29% in off-the-shelf products, 28% in applied research and development and 2% in basic research.

Scurlock predicted that in 1961, 40% of the company's business volume would be in the area of hardware development, 36% in off-the-shelf products, 22% in applied research and development and 2% in basic research.

Chance Vought Given Dyna-Soar Contract

Dallas, Tex.—Contract to develop nose cap assemblies for Dyna-Soar has been awarded Chance Vought Corp.'s Astronautics Division by Boeing Airplane Co. Program calls for fabricating and testing a series of nose caps fabricated of high-temperature resistant ceramic materials and design, development and testing of metal attach rings, heat shields and other structures for fastening the nose caps to the Dyna-Soar vehicle. The company also will design temperature and pressure-measuring installations for the nose caps and support stands to provide data during ground test runs.

Nose cap test program will be run in Chance Vought's ramjet test facility and in its plasmatron equipment, the latter capable of subjecting the specimens to heat exceeding 25,000F.

Although Chance Vought spokesmen decline to discuss the value of the contract, it probably exceeds $1 million.

Mergers And Acquisitions

Burtek, Inc., has acquired Concord Control, Inc., specialists in digital computation, data handling and control systems engineering, from The Giddings and Lewis Machine Tool Co. of Fond Du Lac, Wis., and the officers of Concord. Concord Control will remain a separate corporate entity but, as a wholly-owned subsidiary, it will function as an integrated division of Burtek.

Statham Development Corp., a wholly owned subsidiary of Statham Instruments, Inc., has been merged with the parent company. Under the new arrangement, the former subsidiary will be known as the Electronics Division of Statham Instruments, Inc. Statham Instruments makes transducers and accelerometers and the Electronics Division makes electronic instrumentation equipment.

ITT Laboratories has been merged with ITT Federal Division to form a single operating unit to be known as ITT Federal Laboratories, a division of International Telephone and Telegraph Corp.

D. S. Kennedy & Co. has merged with Electronic Specialty Co. which will consolidate with American Electronics, Inc., to form a new corporation known as Electronic Science and Controls. After these mergers, shareholders of D. S. Kennedy & Co. will hold one share of Electronic Science and Controls for each present share of D. S. Kennedy & Co. Combined sales of the companies are currently at an annual rate of $50 million.

Leeds and Northrup Co., Phila., Pa., has acquired all the outstanding shares of Integra, Leeds and Northrup, Ltd., Birmingham, Eng. The British firm, renamed Leeds and Northrup, Ltd., makes electronic controls and measuring instruments.

Financial Briefs

Rockwell-Standard Corp.'s wholly-owned subsidiary, Air-Maze Corp. of Cleveland, Ohio, will operate as the Air-Maze Division of the parent company. The new division will be under the direction of W. B. Watterson, General Manager, replacing G. M. Walton who is retiring.

Ceramics International Corp. has been organized by a group of production experts who were formerly associated with Advanced Vacuum Products of Stamford, Conn. The company will manufacture ceramic-to-metal fabrications for the electronics industry in its new 5,000-sq.-ft. plant in Mahwah, N. J.

American Brake Shoe Co. has purchased Dynisco, Inc., a Cambridge, Mass., manufacturer of electromechanical transducers and ultrasensitive measuring instruments. Dynisco, founded in 1953 by the brothers Yao Tzu Li and Shih Ying Lee, both professors of engineering at MIT, is expected to have annual sales for 1960 of $750,000.

Gulton Industries, Inc., Metuchen, N. J., has formed Gulton Industries (Israel), Ltd., to manufacture basic electronic products for both local and export

jpl

PIONEERING IN SPACE NAVIGATION RESEARCH

The Jet Propulsion Laboratory in Pasadena, California, has been given the responsibility by the National Aeronautics and Space Administration of managing and executing a number of highly significant explorations in space. They include lunar and planetary missions such as fly-bys, orbiters, and unmanned roving vehicles for the observation of the surface of the moon and the planets. Other missions planned for the future involve trips outside of the ecliptic and beyond the confines of the solar system.

The successful execution of these programs requires extensive research efforts of a basic nature in the areas of celestial navigation and the guidance and control of vehicles operating far out in space. The problem areas being investigated include novel concepts in navigation based on astrophysical phenomena as well as research on inertial, optical, and electro-optical sensors of various types. Other examples of present research activities in this area are cryogenic studies related to gyro and computer techniques, gas lubrication and flotation of sensing masses, research in solid-state physics, and many others.

The Laboratory has a number of positions open for scientists who are interested in working on challenging problems in these areas and who have the ability to investigate novel concepts and try unconventional methods.

Applicants must have an outstanding academic background with a Ph.D. degree, or equivalent experience and a Masters degree, in physics, astronomy, or electrical engineering. A minimum of five years of industrial or academic experience in the following fields will normally be required: **optical physics, astrophysics, cryogenics, inertial guidance, celestial navigation,** and **computer and logic devices.**

Qualified scientists will be offered the opportunity to work in an unusually stimulating atmosphere and will have available excellent supporting facilities for experimental and analytical studies.

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MARCH 13, 1961.

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PUBLISHING DATE: MARCH 13, 1961

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markets. The Israeli firm will be jointly owned by Gulton Industries and the Swiss Israel Trade Bank and will have a working capital in excess of $500,000.

The Bendix Corp. had sales of $787,025,279 during the fiscal year ended Sept. 30, 1960, at 15% gain over last year's sales total of $683,800,000. Income for the year was $26,188,471 compared with $27,404,274 for Fiscal 1959.

Midwest Technical Development Corp. has purchased $25,000 of Astronautics Corp. of America common stock. Another $225,000 is also being furnished by MTDC in the form of debentures with warrants for the purchase of additional shares of Astronautics stock. Founded in the spring of 1959, Astronautics had billings of $192,281 for the year ended May 31, 1960, and has realized sales of $700,000 in the first six months of Fiscal 1961.

Metal and Thermit Corp. has formed a wholly owned subsidiary, Metal and Thermit AG, in Zug, Switzerland. The new company will act as the parent company's sales and licensing representative in Europe.

Susquehanna Corp., Chicago, Ill., has formed a division that includes three companies purchased last year: Computer Engineering Associates, Birdsell Products and Thor Electronics. The new division, named Susquehanna Sciences, Inc., now markets a heliarc welder for welding exotic and dissimilar metals and has received an order from Convair for over 200 power supplies for missile telemetering transmitters.

Thompson Ramo Wooldridge has obtained an option to acquire more than 90% of the common shares of Radio Condenser Co. of Camden, N. J. The shares will be obtained on the basis of .2374 of a TRW common share for each share of Radio Condenser. The entire transaction will involve the acquisition of all of Radio Condenser's 435,815 outstanding shares in exchange for 103,463 TRW shares. Radio Condenser employs about 2,000 people in plants in Camden, Thornwood, N. Y., and Watseka and Hoopeston, Ill., and operates Radio Condenser Co., Ltd., a Canadian subsidiary, in East Toronto.

Two mutual funds, Atomics, Physics & Science Fund, Inc., and Axe Science and Electronics Corp., have purchased 15,000 shares of the stock of Atlantic Research Corp. at $4 a share. Atomics Physics and Science Fund, Inc., purchased 5,000 shares, and Axe Science and Research Corp., the remaining 10,000 Axe Science and Research's purchase brings to 49,000 the number of shares they own in Atlantic Research.

Electronic Systems Engineers

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Electronics Engineers who are qualified, through education and experience, and who are seeking better opportunities to technically express themselves in any of the aforementioned fields, please forward resume to:

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Engineering Personnel Supervisor, Box AW-233
North American Aviation, Inc.
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Columbus 16, Ohio

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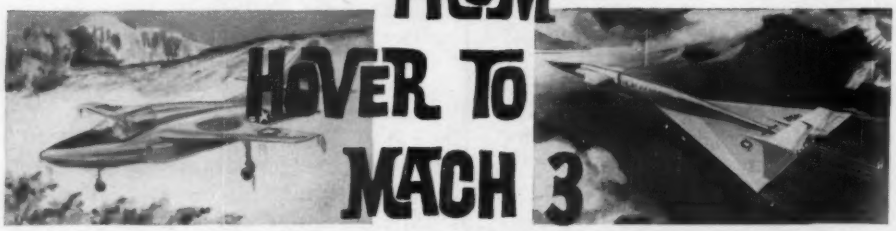

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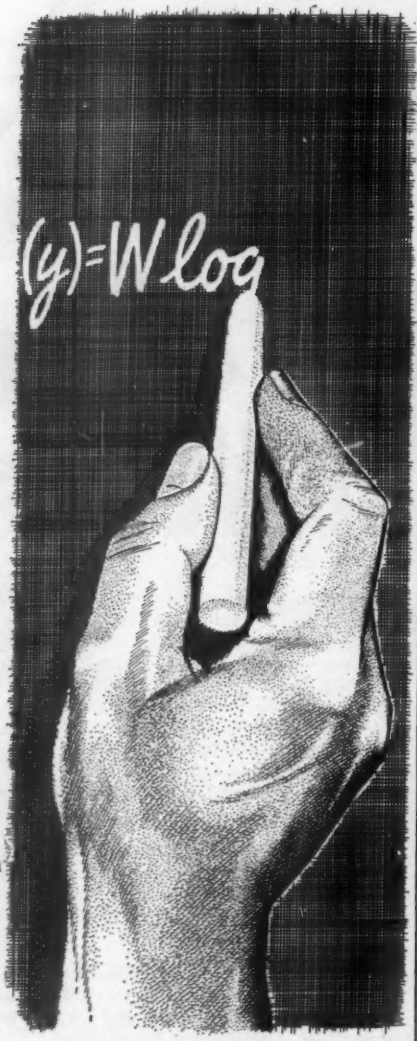

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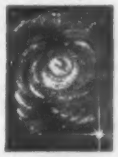

A Division of
GENERAL DYNAMICS

LETTERS

'Laurels' Debated

Being an assiduous reader of AVIATION WEEK prompts me to make a few comments pertaining to the editorial you wrote in the Dec. 26 issue. The title, "Laurels for 1960," of this editorial is supposed to reflect the outstanding achievements of the year that we are about to conclude.

This list encompasses personal achievements together with political figures, organizations and administrative accomplishments. I don't take issue with your selection, although I feel that in our society, devoted to progress, technical and scientific contributions should deserve at least the same emphasis as administrative or organizational accomplishments. Also, I will not mention any names or organizations you listed which could have been advantageously replaced with achievements missing in your list. Nevertheless, I must mention one item, and I am quoting, "Dr. Stark Draper and his Massachusetts Institute of Technology group for their pioneering work on development of inertial guidance systems that came to fruition in operational use with Polaris and Titan."

With all due respect and personal friendship to Dr. Draper and his associates, whom we all like and highly esteem (including myself, of course), your lack of objectivity prompts me to point out the following:

As reported by AVIATION WEEK itself, the very first inertially guided ICBM flew in 1960. It flew on the Atlas missile. This is also probably the very first inertial guidance to go over ICBM distances in the whole world. This singular accomplishment of the Free World certainly is a more than outstanding achievement of which every American, and not only the American Bosch Arma Corp., should be proud.

The system was entirely engineered, developed and put into operational status by the Arma Division of American Bosch Arma Corp. As you can see, this was made possible not by Dr. Draper and MIT, and not on Polaris or Titan, but by the people and on the equipment I mentioned. Within limits imposed by security restrictions, I can tell you that the Arma system uses a set of two-degree of freedom gyros pioneered by ourselves and unique in design, together with a vibrating string accelerometer which was indeed the most significant breakthrough ever accomplished in the guidance field. The guidance system also comprises a fully transistorized digital computer with no moving parts (another "first"), and many other features which I cannot list in an unclassified letter. However, I may tell you that the repeated firings in 1960 far exceeded the most optimistic expectations of performance of both the Air Force and our own Engineering Division.

It seems to me that against this outstanding achievement, which you did not even mention casually, the emphasis that you placed on organizations which can hardly boast of anything approaching this magnitude in the inertial guidance field is somewhat less than objective.

In conclusion, I would like to mention that this criticism pertains to this article alone and not to other editorials of yours, the reading of which I not only enjoy very much, but usually I agree with them in the salient points you make.

DR. PAUL H. SAVET
Staff Scientist
Arma Division
American Bosch Arma Corp.
Garden City, N. Y.

(Dr. Savet misses the point of AVIATION WEEK's inclusion of Dr. Stark Draper and his MIT group in its "Laurels for 1960." This was in recognition of their basic pioneering in inertial guidance dating back to the early postwar era when many competent people questioned whether the accuracy or reliability of inertial guidance systems could ever reach the standards required for long range missile use. Dr. Draper's pioneering stimulated most of the subsequent industrial work in this field which has now expanded beyond many of the original concepts. Operational success of the Titan and Polaris inertial guidance systems during 1960 demonstrated the validity of Dr. Draper's work on which they are specifically based.—Ed.)

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Idlewild Facilities

This letter is written in response to Mr. John R. Wiley's (New York Port Authority) letter in the Dec. 5 issue (p. 126) of AVIATION WEEK regarding the passenger facilities available at the Idlewild terminal.

Normally I feel content to refrain from responding to articles written as "Letters to the Editor." However, when someone with the obvious influence and control that Mr. Wiley most likely has over the New York Idlewild facilities, indicates his complete lack of understanding (as evidenced by his letter) of what good passenger facilities are, it necessitates an answer.

I fly both domestic and foreign airlines; approximately 120,000 mi. per year as part of my professional activities. During these travels I visit most major U. S. cities many times per year.

New York's Idlewild airport facilities have the most modern terminals of almost any U. S. or foreign city that I have seen, but which are beyond a doubt the most inconvenient to the passenger.

I have illustrated some of these inconveniences with the following list:

(1) An arriving passenger on Eastern Air Lines has to tolerate a 20-min. bus ride in order to catch a United Air Lines flight. The minimum reliable time that one can plan on for making such a connection is at least 45 min.—providing no baggage interchange is required (for this makes the connection time about 1½ hr.).

(2) In order to transfer from a United Air Lines flight to an American Airlines flight again requires the 20 min. However, the two terminals are only a one-minute walk apart—but there isn't even a sidewalk connecting the two terminals! If you do want to walk, you must walk out in the middle of the road.

(3) The crowning disgrace of the multiple-terminal approach is the trouble it causes foreign travelers arriving at Idlewild. I think it is actually simpler to fly from one country to another than to change terminals at Idlewild.

No one associated with the New York Port Authority should ever exclaim about New York airport passenger facilities, either at Idlewild or La Guardia. Somehow, Newark air terminal probably was a mistake as it is very convenient for passengers—although probably the New York Port Authority has plans to decentralize it, too.

Finally, I would ask if the New York Port Authority representative has ever tried to take a cab at Idlewild as a means of getting from one terminal to the next in order to make a connection. I also wonder if he has ever tried to get a cab to take him to the New York Port Authority-owned International Hotel near the airport, which is almost a physical impossibility. Beyond a doubt the taxi drivers at Idlewild are the most rude and least controlled of any I've ever seen. Surely this could be regulated by the Port Authority so that there could be some degree of pleasantness.

I suggest that before Mr. Wiley speaks up to defend the most terrible airport terminal facilities (from the passenger standpoint), he travel a bit to see how good they can be at other locations.

RAY L. LEADABAND
Palo Alto, Calif.

Saint Designation

Pardon my apparent lack of irreverence, but would the religious groups who object to the USAF calling its satellite interceptor a Saint (AW Jan. 2, p. 15) object to renaming it Satan for "Satellite Annihilator"? Then, should Satan ever annihilate a foreign spying satellite Devil, it would have earned back its right to sainthood. Furthermore, not being the property of any one church, all of us benefactors could revere it for its deed of mercy.

BRYAN W. FRANKS, CMDR. USN (RET.)
Coronado, Calif.

ARPA Antenna

We are very pleased to have our name mentioned in the Dec. 19 issue of Aviation Week in the picture caption which appeared on p. 79.

We did not build the antenna but we did build the transmitter—the world's largest S-band transmitter—50 megawatts peak power, 50 kilowatts average power, using eight klystrons operating in parallel.

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President
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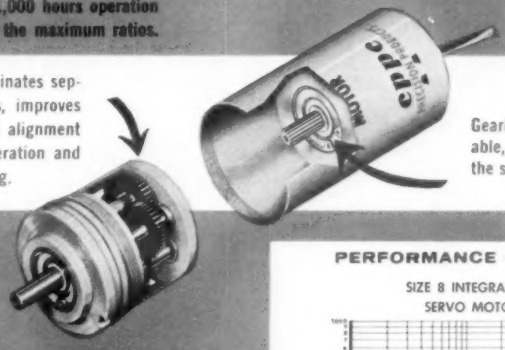
NEW SIZE 8 INTEGRAL GEARHEAD MOTORS

3 Times Torque Load Capacity*

of comparable size 8 gearheads

***Will sustain 20 in-oz torque load for 1,000 hours operation and 100 in-oz momentary overload at the maximum ratios.**

CPPC one-piece gearhead housing eliminates separate gear plates and fastening posts, improves and maintains accuracy through exact alignment of gear clusters, assures smoother operation and more expedient inspection and servicing.



Gearhead and motor are selectable, individual parts enclosed in the same common motor housing.

Clifton Precision, pioneers in postless gearhead construction, introduces the finest in gearhead design—cage-type, one-piece gearhead housing machined from a single block of metal. In these units, exact duplication of gear centers is accomplished through simultaneous boring of permanently integrated bearing plates (patent pending). Positive and permanent alignment of gear clusters composed of AGMA precision Classes II and III hardened-steel gears integral with shafts journaled at both ends in ABEC class 5 bearings, minimize deflection and backlash, maximize torque load capacity, insure smoother operation and continued reliability of performance beyond normal endurance life requirements. Cage-type construction facilitates inspection and lubrication while gearhead is mounted simply by removing motor.

CPPC motors will stand greater heat than ever before due to the use of new materials. See box at lower right.

Write for our free pamphlet which gives detailed specifications of our entire gearhead motor and motor-tachometer line, sizes 8, 10 and 11.

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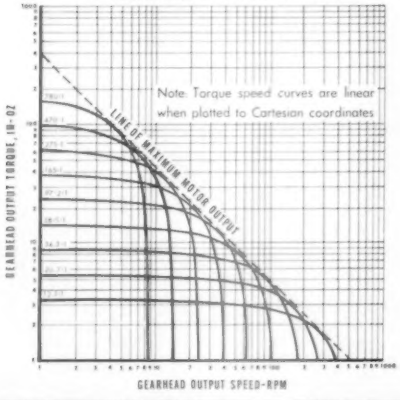
RATIOS		No. of	Dir. of
Size 8	Size 10	Clusters	Rotation
12.09	19.98	2 (3 pass)	reverse
20.63	32.19	3 (4 pass)	direct
34.26	58.28	3 (4 pass)	direct
58.44	93.89	4 (5 pass)	reverse
97.07	169.97	4 (5 pass)	reverse
165.58	273.84	5 (6 pass)	direct
275.02	495.74	5 (6 pass)	direct
469.15	798.70	6 (7 pass)	reverse
779.22	1445.92	6 (7 pass)	reverse

Notes: 1. Any ratio (±3%) is available within the limits of the ratio range at additional cost and may require longer delivery time. 2. Max. backlash = 30 minutes at 2 in-oz reverse gauge load in above units. Inquire if special tolerance is required.

PERFORMANCE CHARACTERISTICS

SIZE 8 INTEGRAL GEARHEAD MOTOR
SERVO MOTOR TYPE ALC-8-□-1


Note: Torque speed curves are linear when plotted to Cartesian coordinates
LINE OF MAXIMUM MOTOR OUTPUT
GEARHEAD OUTPUT TORQUE, IN-OZ
GEARHEAD OUTPUT SPEED-RPM

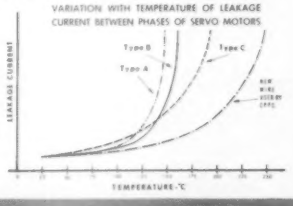
MOTORS

The following CPPC standard motors, electrical characteristics of which can be found in the current CPPC Rotary Components catalog, are offered with our gearheads:

SIZE 8		SIZE 10	
ACH-8-□-1	AMH-8-□-3	ACH-10-□-1	ALH-10-□-1
ACH-8-□-4	ALC-8-□-1	ACH-10-□-4	ALH-10-□-5
AMH-8-□-1	ALC-8-□-4		

CURRENT LEAKAGE

Superiority of insulation in CPPC motors is illustrated by actual comparative curves shown at the right.



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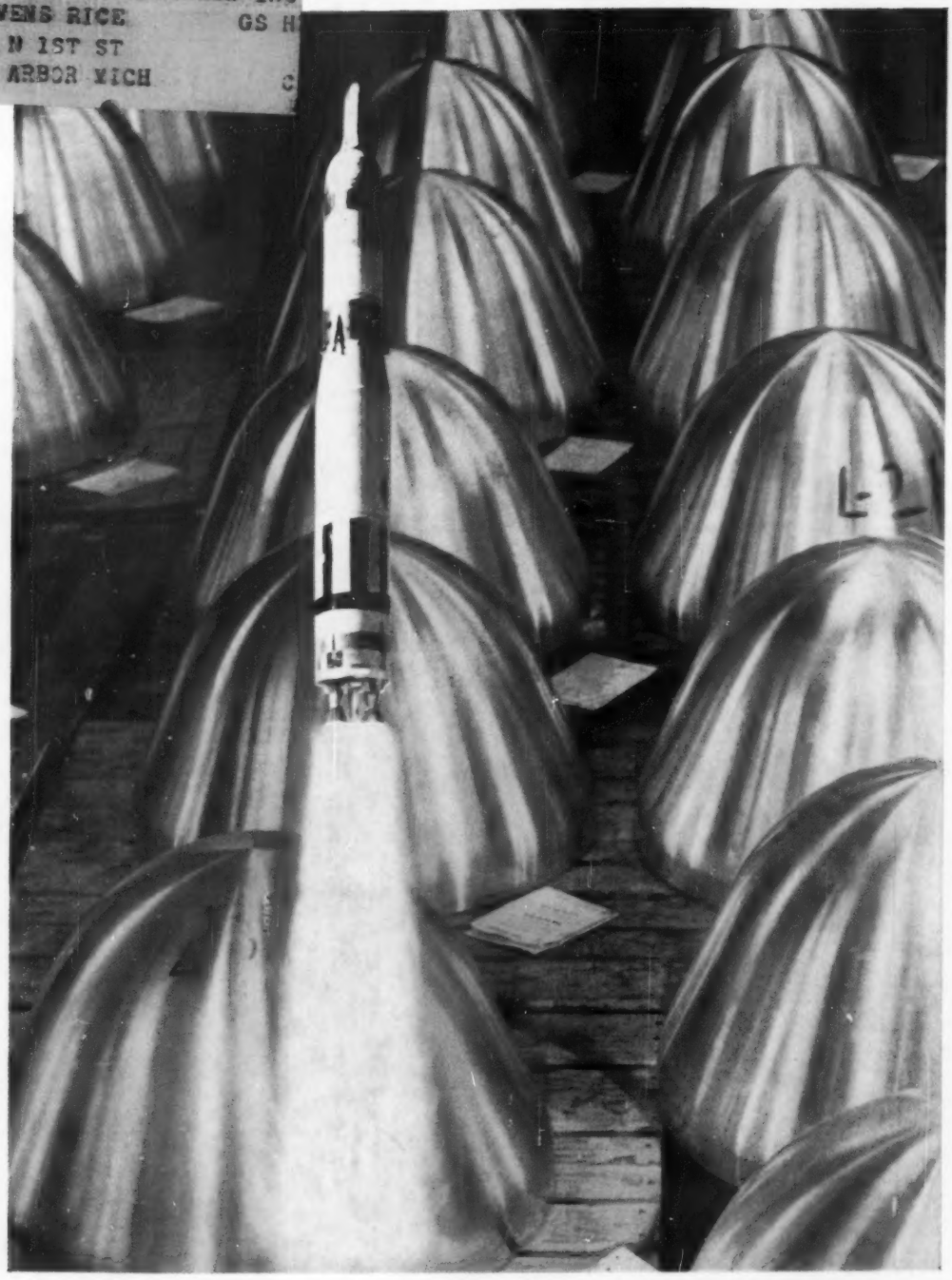

Building beaks for ballistic birds. Each of these stainless-steel hemispheres at Avco's Lycoming Division plant will soon become part of an ICBM nose cone. Over them will go new heat shield materials developed by our Research and Advanced Development Division—for protection against searing re-entry conditions. Avco now designs and builds nose cones for Atlas, Titan, and Minuteman.

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